PERIODICAL ROOM
GENERAL LIBRARY
UNIV. OF MICH.

Popular Science

MONTHLY Founded 1872

FEB 2 1928

March
1928
25 cents

In This Issue

Why the Navy Lost the S-4

All the New Discoveries and Inventions

For men who enjoy *doing* the job

Larger face lets your blows strike true; shorter neck gives better balance; knife-like claws pull any nail. It has power, accuracy and balance . . . and the screw wedge which re-tightens the handle when it loosens.
Model HF 31 1 lb. $1.50

All wood handles loosen from steady pounding and shrinkage, but only a Plumb can be tightened just by turning this patented screw-wedge.

For machinists, motorists and for heavy work around home. Oblong eye takes an over-size handle; head off-center gives more power to your blow; cone-shaped pein spreads rivets instead of mashing them.
No. HF 373 1 lb. $1.15
Heavier weights in proportion

YOU men whose sport is in making things and not in the things you've made—

Who would rather grip a high-grade tool than any steering wheel—

You men whose work-bench is your golf course . . . whose tools are your pals—for you Plumb Tools are made.

Grip the Nail Hammer! Feel that balance? . . . how it tunes itself to your swing? Every line of the handle, every curve of the head is designed to get that result.

Pull a headless nail; grip the slimmest brad. See how those claws take hold!

Or the Hatchet . . . there's a keen blade. Toughened through and through by a special tempering process. Slice a shaving . . . or sink the blade deep. It goes just where you aim it.

Or the Ball Pein . . . for your heavy work. You'll find Power there! The weight is placed off-center to give more drive to your blow. The pein spreads rivets instead of mashing them.

Special steel, heat-treated by Plumb's armor-plate process, gives this tool an edge that stays sharp. Plumb tempering gives it toughness and strength to stand all-around work. Plumb's screw-wedge gives it security, because you just turn the screw when the handle loosens.
No. 2962 . . . . . $1.60
Prices in Far West or Canada slightly higher

Every head a rust-proof ivory black. Every handle of sturdy hickory, double-tested, and stained an enduring red.

And never a loose handle or wobbly head to make your tool unsafe. For you just turn the patent screw wedge when a Plumb Handle loosens . . . and immediately it is tight again.

Fine tools—every one of them. Fine in design . . in finish—and in those small details that the tool lover knows.

Your hardware man has Plumb.

FAYETTE R. PLUMB, INC.
PHILADELPHIA, U. S. A.

PLUMB
DOUBLE LIFE
Hammers Hatchets Files Sledges Axes

WHAT IT MEANS TO BUY A USED CAR FROM A CADILLAC-LA SALLE DEALER

Good Used cars bought from a reliable dealer represent highest dollar value. Used cars bought from a Cadillac-La Salle dealer represent much more than dollar value. They are so sold as to build Good Will. Unless the Cadillac-La Salle dealer is a reliable used car merchant, his reputation will suffer. In the same ratio, his value to the Cadillac Motor Car Company lessens. The Cadillac Motor Car Company insists upon honest merchandising practices.

CADILLAC MOTOR CAR COMPANY
Division of General Motors Corporation
DETROIT, MICHIGAN

You will find some interesting facts in the booklet "What a Good Used Car Can Give You." Requesting a copy does not obligate you in any way.

CONVENIENT TERMS ARE ALWAYS AVAILABLE

WHAT IS NEW THIS MONTH

Table of Contents for March

LEADING ARTICLES

MAKING SUBMARINES SAFE . . . . *By John Walker Harrington* 13
The tragedy of the *S-4* sinking, and what it taught the Navy
IS LOST EXPLORER NOW JUNGLE GOD? . . *By Francis Gow Smith* 16
Weird possibilities hinted by a mysterious disappearance
WHY WE ARE IMMUNE TO SOME DISEASES . . . *By Lidda Kay* 21
First steps that foretell greater medical conquests to come
"WE" SMASH MORE RECORDS . . . . . *By Ellsworth Bennett* 23
The amazing mechanical performance of Col. Lindbergh's plane
ROMANCE JAMS THE LOG JAMS . . . . . *By Arthur Grahame* 24
What veteran lumbermen do when the spring drive comes down
SPERRY—COMPETITOR OF THE SUN . *By Frank Parker Stockbridge* 26
The story of a mechanical genius, his searchlights, and his gyros
WHERE DID YOU CATCH COLD? . . . . . *By P. A. Carmichael* 28
New things doctors are learning about contagion and overeating
A NEW BROOD OF LINDBERGHS . . *By Maj. Gen. James E. Fechet* 29
How the Army is teaching fledglings to fly
BITS OF OLD CLAY KICK UP A BIG ROW . *By George Lee Dowd, Jr.* 31
An archeological "find" that started a scientific battle
THE REAL STORY BEHIND THE NEW FORD CAR . *By Edwin Ketchum* 32
How one man's ingenuity met a great industrial crisis
WHAT WE OWE TO NEWTON . . . . . *By Arthur A. Stuart* 34
The story of a young farm boy who explained the universe
TRIUMPHS OF RADIO'S "HAMS" . . . . *By Alden P. Armagnac* 39
How amateur tie-ups span continents and serve nations
SEA WAVES TO DRIVE NOVEL POWER PLANT 41
How a Navy engineer would harness the ocean's energy
THE WORLD'S GREATEST TIMBER CROP 42
A single island's colossal industry
OUR BATTLESHIPS ON WHEELS 44
By Rear Admiral Charles P. Plunkett, U. S. N.
How American naval guns turned the tide in France
ROBBING FOG OF ITS PERILS . . . . . *By Norman C. McLoud* 47
Latest strides of progress to aid navigators
COAL TOO USEFUL TO BURN . . . . . *By A. C. Fieldner* 49
A noted chemist's vision of the treasures within black lumps
PLANTS MADE BY CHEMISTRY 56
Laboratory creations that almost outdo nature
HE REBUILT HIS HOUSE AND SAVED $6,000 . *By John R. McMahon* 71
Making a convertible home for one or two families
WHEN YOU BUY A CAR— . . . . . *By Martin Bunn* 74
Gus and Joe tell how "service" and "trade allowance" affect your choice
DECIDING WHAT TOOLS ARE GOOD . . . . . *By F. G. Pryor* 8
OUR READERS SAY— 10

FICTION

ALL METAL . . . . . *By Andrew A. Caffrey* 18
A high-geared story of an air liner, a girl, and a dramatic rescue at sea
THE MOVIE MAKER—PART TWO . . . . *By S. W. Newmeyer* 36
Thrills that the cinema audience never sees, in a fascinating novel

RADIO

LOCATING YOUR RADIO TROUBLE . . . *By Alexander Senauke* 68
A GUIDE IN CHOOSING A RADIO SET . . . . *By John Carr* 70
POWERING YOUR ELECTRIC SET . . . . *By Alfred P. Lane* 82

THE HOME WORKSHOP

THE SIMPLEST FLYING MODEL . *By J. D. Bunch and A. F. Koch* 81
TRICKS OF THE TOOLMAKER . . . . *By Hector J. Chamberland* 88

Automobiles

"Road Yacht" Complete Home . . 52
Who Is Father of Automobile? . . 54
Paving Put to Test 54
Open Car and Sedan in One . . . 59
Garage Door Dogs 61
Novel One-Wheel Luggage Carrier for Motor Cars 61
Know Your Car 62
New Paint Striping Device Lets Anyone Decorate Auto . . . 63
A Bed in a Motor Car 77
A Quick-Acting Auto Jack . . . 77
Back Through Garage Doors. . . 77
Tool Boxes in the Floor 77
Swinging Stop Light 77
Ten Dollars for an Idea 77

Astronomy

Sun's Collapse Predicted . . . 50
Big New Meteorite Studied. . . 52
Star a Pulsating Gas Bubble . . . 59

Aviation

Oil Engine and Cheap Helium May Start New Flying Epoch . . . 51
Navy Issues Ocean Air Maps . . 55
Globe-Circling Dirigible Nears Completion 57
First Aquatic Air Glider 57
Barbed Anchor Aids Airships. . . 57
Caterpillar Landing Gear . . . 57
First Floating Dock for Seaplanes . 57
"Aerial Signpost" Directs Flyers . 57
Seaplane Can Go 4000 Miles . . . 58
Planes Use Costliest Wood at $600 for Thousand Feet 58
New Light's Colored Rays Fight Fog 61

Engineering

Artificial Gales Test Skyscraper Models 50
Dam Holds Water with Water . . 53
Plan to Utilize Moon Power . . 53
Twin Panama Canal Foreseen . . 54
Dam Is Engineering Feat . . . 54
Heating Plants on Roofs Next? . . 55
Steam Well Power Unlimited . . 58
A $275,000 Floating Road . . . 58
Bridge Nearly 500 Feet High . . 58
Engineers' World News Service . . 64
Monorail Cars Under River . . . 64

Health and Hygiene

Skeletons That Teach Health . . 50
Blood Pressure and Motoring . . 51
How Colors Aid Eyesight . . . 53
Heart No Pump, Says Doctor . . 64
Why Boys Eat So Much 65
New Gains in War on Disease . . 138
Perfumed Anesthetic Is Latest . . 142

March, 1928, Vol. 112, No. 3. **Popular Science Monthly** is published monthly at 250 Fourth Avenue, New York, N.Y., by the Popular Science Publishing Co., Inc. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Chicago, Illinois. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Copyright, 1927, by the Popular Science Publishing Co., Inc. Single copy, 25 cents. Yearly subscriptions to United States, its possessions, and Canada, $2.50; foreign countries, $3. The contents of this magazine must not be reprinted without permission. In presenting in its editorial columns numerous stories of new products of applied science, **Popular Science Monthly** does not underwrite the business methods of the individuals or concerns producing them. The use of **Popular Science Monthly** articles for stock-selling schemes is never authorized. O. B. Capen, President and Treasurer; R. C. Wilson, Vice-President; A. L. Cole, Secretary.

Laboratory Discoveries

Health Rays Pierce Clothes' Holes Alone, Tests Show 51
Giant Plant from X-Rayed Seed . 51
Sky Plays with Sound Waves . . 62
Cheap Cornstalk Walls Now . . 63
Sugar Produced by Chemistry . . 64
A Wireless Electric Light . . . 132

New Devices for the Home

New Knife Grinder 66
Portable Electric Radiator . . . 66
Door Knob Burglar Alarm . . . 66
Poisons Safeguarded in Novel Medicine Chest 66
Bread Cabinet Hides Goodies in Secret Compartment 66
Speedy One-Hand Flour Sifter . . 66
Reversible Broom Saves Bristles . 66
Handy Funnel Fills Your Radiator Water Pans 66
Table and Radiator in One . . . 67
Keeps Your Clothespins in Reach . 67
Novel Scissors Adjustable for Wear 67
Bakes Potato in One Minute . . 67
New Cooker Saves Flavor . . . 67
Makes Siphon of Your Ginger Ale Bottle 67
New Laundry Bag Holder . . . 67
Mends Sagging Upholstered Chairs . 67

New Processes and Inventions

Turns Sound to Light to Help Deaf Hear 51
Saw Uses Sand to Cut Rock . . . 52
Gear-Wheeled Roller Skates . . . 53
Portable Track for Racing Greyhounds 54
Wheels Made of Cotton 54
New Way to Tell Time in Bed . . 58
New Chemical "Ice" for Rink . . 58
Steel House Erected in Little Over Three Hours 59
Foolproof Elevator 59
Magnifying Your Strength . . . 59
Phonograph Relieves 'Phone Girls . 60
A Vest Pocket Ash Tray 60
Eggs Kept Fresh by Daily Ride on Ferris Wheel 60
Ending Nuisance of Wet Umbrella . 60
Novel Golf Scorer in Watch Case . 60
What a Harmonica Grows Up to Be 60
Bundle-Tying Device 61
A Slot Machine Soda Fountain . . 61
Odd Envelope Licker 61
Novel Saw Cuts 24 Piles in 50 Minutes 62
Playing Cards in Tile Form Defy Wind and Hard Usage . . . 62
Clock Times Life of Truck . . . 62
A Mechanical Professor 63
Electric Signs Flash Paris News Bulletins 64
Optical Device Gages Heat . . . 65

Photography

Photos of Heart Electricity . . . 51
Toad Challenges Camera's Speed . 63

Radio

Hotel Radio in Each Room . . . 55
Do Radio Waves Never Die? . . . 65

Unusual Facts and Ideas

Was America Man's Birthplace? . 50
Creeping Baby Is Trotter. 51
Mummies Sought in Arctic . . . 51
Insects Turned to Metal 51
Bottle Traces Ocean Current . . 52
How to Name a New Animal . . 52
Swastika May Trace Races to Lost Pacific Continent 52
Self-Sprinkling Roads Built . . 53
Sea Lions Caught with Nets . . . 53
Five-Mile Road of Gold Ore . . . 53
Junk Makes Queer Golf Links . . 53
Mail Trapped by the Desert . . . 55
Oil Ditch a Fabric Pattern . . . 55
Smaller Dollars Save Millions . . 55
Making All Russia Gas-Proof . . 55
Building Wreckers Imitate Explosion 55
Hens Smash Laying Records . . 55
Toy Car Claims Speed Mark . . 58
Baboons As Servants Advised . . 58
Trees Gage Wind Velocity . . . 134
Any Questions? 59
Bright Children Not "Queer" . . 59
Old Maps Make Lamp Shades . . 62
Fingerprints Identify Races . . . 62
How Much Do You Know of the World You Live In? 63
Tree Stump an Incinerator . . . 63
Old Cement Mine a 40-Acre Mushroom Farm 65
"Coldest Spot" Is 452 Below . . 65
'Phone Insulators' Bath Day . . 65

For the Home Owner

Filling Bathroom Cracks. 102
How to Conceal Cracks in Plaster . 102
Sealing Fire Cracks 104
Plumbing Hints for Home Owners . 130

Hints for the Mechanic

Using Gears for Indexing Work on the Grinder 90
Depth Gage for Lathe Drilling . . 90
Extension Tool Holder for Planer . 90
Bench Block Fitted to Hold Thin Metal 90
Universal Joint for Floating Reamer 90
Indexing Fixture for Engine Lathe . 90

Ideas for the Handy Man

How to Care for Your Tools. . . . 86
How to Lay Out Your Own Shop for Decorative Metal Work . . . 92
Scenecraft—the Exterior Set. . . 94
Tools—Pride of My Farm . . . 96
Wood Turning Simplified . . . 98
Blueprints for Your Home Workshop 106
Paint Removers You Can Make . 112
How to Remedy White Paint's Yellow Tint 112
Horseshoe Magnet an Aid in Home Workshop 114
Keeping Nickel-Plated Hardware Bright 114
A Small Plant Stand Anyone Can Make. 120
Dowel Sticks As Xylophone Keys . 125
Carpenters' Level Used for Sighting Long Lines 129
Razor Blades Aid Modelers . . . 129
Plumbing Hints for Home Owners . 130
Walnut Shell Made into "Comicull" Elephant. 131

Are You Abreast of the Times?

If you can't answer the questions below, turn to the page indicated

1. Has blood pressure any connection with auto accidents? (p. 51)
2. Who will transmit for you, without charge, a radio message to anyone, anywhere? (p. 39)
3. What kind of a cold is not contagious? (p. 28)
4. For what is Sir Isaac Newton famous? (p. 34)
5. Why are we to have smaller dollar bills? (p. 55)
6. What star is believed to be a pulsating bubble of gas? (p. 59)
7. Why did Henry Ford take small boys riding in the first of his new cars? (p. 32)
8. What is the result of the U. S. Bureau of Standards' $50,000 investigation to find uses for farm waste? (p. 63)
9. Where is the coldest spot on earth? (p. 65)
10. How can you use imaginary lines to make your house a convertible one or two-family dwelling? (p. 71)
11. What is the latest invention of Elmer Sperry, perfecter of the gyro? (p. 27)
12. How does a new type of dam hold back water with water? (p. 53)
13. Who is said to have a prior claim over that of Gottlieb Daimler, German engineer, as the "father of the automobile?" (p. 54)
14. To what diseases can man, today, make himself immune? (p. 22)
15. What is the proper way to bend bamboo, in making model airplanes? (p. 81)
16. What planet shoots huge volcanic bombs into space? (p. 50)
17. How do new species of animals get their names? (p. 52)
18. Where is the American factory which, making wood alcohol from coal by a new process, may supply the whole United States? (p. 49)
19. What "important archeological discovery" is called a hoax by scientists of high repute? (p. 31)
20. What chemist has at last duplicated nature's feat of making sugar and starch, as plants do, from water, sunshine, and carbon dioxide? (p. 64)
21. Where does the Army Air Service teach young men to fly? (p. 29)
22. How do lumberjacks break a log jam when they can't find the key-log? (p. 24)
23. Can the waves be harnessed for electric power? (p. 41)

Independence Hall at Philadelphia, glorious in its historic surroundings stands as an ever present reminder of every American's desire.

Independence

The courage and determination of our forefathers made possible our present National well-being. Thrift and the continuous purchase of sound securities will make possible for the provident, monetary independence in their declining years.

This old-established investment banking institution has earned the confidence of thousands of investors in every state of the United States and in more than 50 countries and territories abroad.

It merits your confidence too, and the securities which we recommend to you may be regarded as a safe investment for your funds.

Let us furnish detailed information concerning this House and the sound investments it offers.

Send for Booklet "1-75"

The F. H. SMITH Co.
Founded 1873
Investment Bankers
Smith Building, Washington, D. C.
285 Madison Ave., New York City
Branch Offices in — Chicago — and Other Cities

Kindly send without obligation your investment booklet and information relative to investments you offer.

NAME_____

ADDRESS_____ "1-75"

How a *Big Load* Was Lifted *from* Harry Wilson's Mind

By WALLACE AMES, *Financial Editor*

THE family had finished its dinner early. Harry Wilson had about exhausted his evening paper and was ready for whatever might turn up. His wife was upstairs going through the nightly tussle with two lively youngsters, getting them stowed away to bed.

Ding-a-ling a-ling rang the telephone. Mr. Wilson answered. "Gee, I'd like to, Bob, but just hold the wire a minute while I check up with Vi."

"Oh, Vi!" Wilson called upstairs, "Bob Collins is on the 'phone. He and Nan want us to come over this evening. How about it?"

"Mercy, I wish we could, Harry," called his wife. "We always have a good time at the Collinses. But there is something I must get done tonight. Ask him to excuse us this time. Tell Nan I'll call her up tomorrow."

"What's the big rush job for tonight, Vi?" inquired her husband, as she came down stairs.

"Betty's new dress. I must get it finished so she can wear it at her birthday party tomorrow."

"Why, I thought Mrs. Bender was taking care of all your sewing," remarked Harry.

"She was over all day," explained Mrs. Wilson, "but there was so much to do she couldn't finish. Betty is so excited over this new dress that I want to finish it for her myself tonight.

"Mrs. Bender wanted to stay until the work was done. She's so willing, but I couldn't let her do it. She has three children of her own, you know. The youngest is only five. There is no one at home to look after them while their mother is out sewing and I hadn't the heart to let her stay after five.

"It's too bad Mrs. Bender has to be away from her children all day, but she must go out sewing to feed her family and keep a roof over their heads. I feel so sorry for her."

"According to neighborhood gossip," observed Mr. Wilson, "Mrs. Bender got a lot of insurance money when her husband died."

"She did," replied Mrs. Wilson, as her flying fingers were finishing button holes and sewing on buttons. "There was $10,000 and that *is* a lot of money. But the cemetery plot, burial expenses and other bills ate up over $2,000. and she invested the rest partly in vacant lots and partly in mining stock that didn't turn out so good.

"Mrs. Bender was telling me all about it this afternoon. The lots were supposed to be right on the road leading to the new bridge and the mining stock promised to pay 12%. The stock proposition turned out to be a fake and she will probably lose all she put in it. As you know, they finally changed the location for the new bridge. Some day Mrs. Bender will probably be able to sell her lots, but she will hardly get as much as she paid for them. In the meantime, she has to pay taxes and she is getting no income from her investment."

"That's tough," mused Harry. "But you'd think she'd have known better. I'll bet you wouldn't waste our insurance money like that."

"I hope not," said Vi, with semi-assurance, "but I remember when Mrs. Bender made her investments I agreed with her that she was making a clever deal. It is too bad she did not have someone with a wise business head to advise her."

"She should have known enough to make a safe 6% investment," said Harry, as though to dismiss the subject with a few words of wisdom.

"Yes," agreed his wife. "She thought something of that at the time, but 6% on the $8,000 she had left is only $40 a month and you can't support a family on that. So she thought in some way she had to make the money go farther."

"Too bad," said Harry, as he got out the cards for a game of solitaire.

But he could not get the subject of life insurance and that inexperienced mother's predicament off his mind. Thinking more of the future possibilities in his own family than of the cards, he overlooked many plays, finally lost interest in the game and gave it up.

"Vi, I can't get Mrs. Bender out of my mind, and for the first time since we were married, I am beginning to wonder what would happen to you and our kiddies if I should die."

"Nonsense, Harry, get such unpleasant thoughts out of your mind. You are perfectly healthy. Let's change the subject."

"No, let's not change the subject," insisted Harry. "Let's be serious.

"You know, I think we have both looked at this matter in the wrong way. We have been pretty careful and are getting along

(*Continued on page 1*)

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

How a Big Load Was Lifted from Harry Wilson's Mind

(*Continued from page 4*)

nicely. Thanks to the building and loan we have over $4,000 paid on the house, my last deposit gave us over $900 in the savings bank, we have paid $3,800 on our 50 shares of preferred stock in the electric light company, Betty has $300 in the bank, Paul has over $200 and there's the $10,000 insurance. That seems like a lot of money. But just wait a minute while I do some figuring."

After Harry had worked with pencil and paper for a few minutes he resumed his discussion. "Here is our picture for the next few years. We must pay $83.33 on the house every month for six years more. And $75 a month for the next ten months before we own our public utility stock outright. Taxes and upkeep on the house are about $300 a year.

"If I should die, you ought to be in position to pay off the mortgage and pay up the stock so you wouldn't have to worry about them. Right now that would take about $5,900. What would be left, considering all the money you would have, including even the children's bank accounts?

"$10,000 insurance, stock worth about $4,500, savings $900 and the children's money $500 make not quite $16,000. So after paying up the mortgage and the stock, you would have about $10,000 left. That would bring in $50 a month at 6%. Right off the bat $25 of it would be eaten up by taxes and house repairs. That leaves only $25 for food, clothes, coal, educating the children and other necessary expenses.

"Gee, Vi, you'd be as bad off as Mrs. Bender," said Harry.

"Oh, we'd get along some way, but nothing like that is going to happen," Vi tried to reassure Harry.

"I am just as hopeful as you are, Vi, about the future, but just the same it would take a load off my mind to know that you were better provided for in case of the unexpected. And so," said Harry with credible determination, "I am going to get this fixed up right away.

"In fact, I guess I'll go over now and see Bob Collins myself. He is in the insurance business.

"I'll get him to help work out the right program for us. And I'll send Nan over here to keep you company as I probably won't get back until we have thrashed out all the pros and cons."

* * * * *

It was a long session that Wilson and Collins had together that evening, and one thoroughly (*Continued on page 6*)

Get rid of money worries *for good!*

TWO MEN were talking in a club-house reading room.

"Everything's going pretty well with me —*now*," said one of them. "I make enough money to pay the bills, enough even to take a vacation now and then. But I sometimes wonder how it would be if anything happened to me. I know perfectly well the house might be sold, my son taken out of school..."

The other man smiled.

"That's just the way I was fixed," he said. "And then a funny thing happened. I answered an advertisement and got hold of a copy of the Phoenix Mutual 'Prosperity Plan.' Maybe you've heard of it. I filled it out.

"I was paying 6% interest on our mortgage at the time. The Phoenix people showed me how by paying only about 1½% more I could fix it so the bank would hand the home over to my wife clear of debt. That was the end of that worry.

"Then they made a special arrangement that will put Jimmie through college. That fixed *that*. And just recently they fixed up what they call an 'income agreement'—and now the family will have an income of $100 a month after I'm gone.

"So the only things I had been worrying about are taken care of—and all because I filled out that little piece of paper!"

WOULDN'T you like to make *your* life plan financially foolproof? Wouldn't *you* like to get rid of money worries for good?

You can. The coupon at the bottom of this page will bring to you, free, the remarkable Phoenix Mutual "Prosperity Plan."

Sending for it is the first step towards real independence—protection for you and your family no matter what happens—an education and every advantage for your children—leisure and comfort for yourself in your later years.

There's no obligation. Send for your copy *now*.

PHOENIX MUTUAL LIFE INSURANCE COMPANY

Home Office: Hartford, Conn. • • First Policy Issued 1851

TO GET THESE . . . MAIL THIS

HERE are just a few of the things you can do under the Phoenix Mutual Plan:

1 RETIRE with an income when you are 60 or 65.
2 REALLY own your home.
3 SEND your children to college.
4 CREATE an estate.
5 MAKE sure your income will go on even though you become totally disabled.
6 LEAVE an income for your family.

PHOENIX MUTUAL LIFE INSURANCE CO.
328 Elm Street, Hartford, Conn.

Send me by mail, without obligation, my copy of your "PROSPERITY PLAN"

NAME .....
BUSINESS ADDRESS .....
OR
HOME ADDRESS .....
CITY ..... STATE .....
DATE OF BIRTH .....

Retire in 15 years

on your Present living Budget

by investing in safe 6½% First Mortgage Bonds

Follow the definite plan given in this book, and your financial independence is won.

The plan works just as surely, whether you are now earning $1,000 or $100,000 a year.

The way is certain—each step plainly indicated and absolutely safe—independent of luck, business genius or speculation.

Every fact has been harvested out of the 47 years' experience of Cochran & McCluer in the first mortgage investment banking business.

The plan is so simple, anyone can understand it—so definite anyone can follow it—and so certain, no one can fail.

In addition to the Financial Independence Plan and the unique budget schedule, the book gives suggestions that enable you to enjoy more of the good things of life, both while building your independent fortune and after you have attained it.

We invite the most skeptical to read this plain, straightforward, interesting book.

Send coupon. We employ no salesmen, therefore none will call.

P-1-28

Cochran & McCluer Co.
46 N. Dearborn St., Chicago, Ill.
Please send me, without obligation, your book, "How To Retire In 15 Years."

Mail this

Name.....

Street.....

City.....*State*.....

Cochran & McCluer Co.

Established 1881—Never a loss to any investor.

46 North Dearborn Street
CHICAGO

The Electrician's Wiring Manual

By F. E. SENGSTOCK, E. E.

Contains all the information needed for the proper installation of lighting and power systems in houses and other buildings.

It completely covers inside electrical wiring and construction in accordance with the National Electric Code. *Pocket size—flexible binding*

448 pp. Price, $2.50

POPULAR SCIENCE MONTHLY
250 Fourth Ave. New York City

How a Big Load Was Lifted from Harry Wilson's Mind

(Continued from page 5)

worthwhile. People sometimes regard their financial affairs as private. They don't like to talk about them to others. Perhaps it is because we like to make believe that we are better off than we really are. But they called a spade a spade that night discussing the facts just as they were and the result was a very sound and sensible insurance program for Harry Collins. In outline form it was as follows:

Immediate obligations in event of Wilson's death:

Sickness, burial and other expenses	$2,500
Retirement of mortgage (estimated)	5,000
Balance due on securities being purchased	750
Immediate cash outlay	$8,250

(Continued on page 7)

To Help You Get Ahead

THE Booklets listed below will help every family in laying out a financial plan. They will be sent on request.

"Ideal Investments" is the designation universally accorded Smith First Mortgage 6½% Bonds which carry attractive tax refund features. A history of the House and information relative to their bonds and the safeguards that surround every issue they offer may be obtained by addressing the home office of The F. H. Smith Company, Smith Building, Washington, D. C.

The House Behind the Bonds reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address: Fidelity Bond & Mortgage Co., 1188 New York Life Building, Chicago, Ill.

Behind the Scenes Where Bonds Are Made tells how you can retire in fifteen years and have an income equal to your present living budget. This booklet can be secured by writing to Cochran and McCluer Company, 46 North Dearborn Street, Chicago, Ill.

How to Get the Things You Want tells how you can *use* insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

Thirty-two page illustrated booklet, describing one of the largest public utility companies, of interest to investors. Utility Securities Company, 230 S. La Salle St., Chicago, Ill.

The Common-Sense Test of Investment Trusts suggests an easy method by which you may correctly judge the worth of any investment trust before putting your money into it. United States Fiscal Corporation, 50 Broadway, New York, will send a free copy if you request Circular CS.

The Making of a Good Investment tells how 6½% can be made on investment in First Mortgage Bonds in units of $50, $100, $250, $500 and $1000; how the bonds are protected and how simple it is to purchase them. For a copy of this booklet address United States Mortgage Bond Company, Limited, Detroit, Michigan.

We Guarantee You $10,000

on an investment of $63.00 monthly for 120 months.

Investors Syndicate Installment Certificates are backed by $110 in conservative first mortgages for every $100 of liability and, in addition, by the guarantee of a third-of-a-century-old house with assets in excess of $20,000,000.

Here is an easy, convenient plan by which you can set a goal of $1,000, $5,000 or $10,000 for yourself—*and be guaranteed results.*

Mail the coupon today for illustrated book, "The Guaranteed Way to Financial Independence."

INVESTORS SYNDICATE
Established 1894
Home Office:
100 North Seventh Street
Minneapolis, Minn.
Offices in Principal Cities

NAME.....

ADDRESS.....P.S.-21

TWENTIETH CENTURY

BOOK OF

Recipes, Formulas and Processes

This book of 800 pages is the most complete Book of Recipes ever published, giving thousands of recipes for the manufacture of valuable articles for everyday use. Hints, Helps, Practical Ideas and Secret Processes covering every branch of the useful arts are given.

10,000 Practical Formulas—The Best Way to Make Everything

A book to which you may turn with confidence that you will find what you are looking for. A mine of information, up-to-date in every respect. Contains an immense number of formulas that every one ought to have, that are not found in any other work.

Price, $4.00

Popular Science Monthly
250 Fourth Avenue, New York

I *will* do it!

That spirit will carry *anyone* to his goal. No matter how high your objective—no matter how difficult its conquest may seem—the simple, solemn determination, "I *will*," is sure to carry you far.

To those who would like a little encouragement and advice on investing money, the Fidelity Bond and Mortgage Co. is sending an understandable booklet called "The House Behind the Bonds." It shows how "Fidelity Guarantees every Bond" and will be sent to you *if you will write.*

FIDELITY BOND & MORTGAGE CO.
H. U. MENTEER, *President* INCORPORATED 1853

660 Chemical Bldg., St. Louis
1188 New York Life Bldg., Chicago
378 Colorado Nat'l Bank Bldg., Denver

FIDELITY MEANS KEEPING FAITH
L1268

FREE BOOK *for* INVESTORS

Send now for the book that tells how you can buy bonds with small regular payments. You can deposit small sums with us and get 6% interest on these deposits while paying for the bonds—you can buy $50—$100—$250 or $1000 bonds one at a time or in large numbers. You can fit your investment program to your pocket book, make your fortune grow steadily, and build a permanent income. We will send full list and description of United First Mortgage Bond issues with the booklet. When you start clipping coupons you start toward a substantial income and freedom from financial worry. You get a good yield with safety. You enjoy dealing with us as your fortune grows. Get the book today. Just send coupon.

WRITE TODAY

United States Mortgage Bond Company
Howard C. Wade, *President*
Resources $24,000,000
365 U. S. Mortgage Building
Detroit, Mich.

UNITED STATES MORTGAGE BOND CO.,
365 U. S. Mortgage Bldg., Detroit, Mich.
Gentlemen: Please mail copy of book, "The Habit of Success".
Name_____
Address_____
City_____ State_____

How a Big Load Was Lifted from Harry Wilson's Mind

(Continued from page 6)

To meet this outlay and provide something extra, Wilson's present $10,000 policy was reserved, to be paid in one sum. It was planned to invest whatever remained ($1,000 to $1,750 or more) in high-grade bonds as a sort of permanent emergency fund.

* * * * *

Estimated minimum monthly income needed by Mrs. Wilson to get along as a widow	$275
Average monthly dividends on public utility stock	25
Interest on savings bank balance	5
Income from invested balance of original insurance policy	5
Balance of monthly income to be provided by new insurance	240
Total monthly income from insurance and investments	$275

* * * * *

New insurance was taken on the "monthly income" plan which provided that $240 would be paid to Mrs. Wilson each month for 20 years (or to the children in the event of her death within that time).

In the event of Mr. Wilson surviving for 25 years, at which time he would be 60 and his children probably self-supporting, the cash surrender value of his insurance would purchase a life annuity for himself and Mrs. Wilson of about $1,400.

Instead of one large policy, several smaller ones were taken out with premiums evenly distributed through the year. The average monthly deposit after the first year was $75.

This premium item is not an expense to the Wilsons, but an investment, because, if the insured lives he and his wife will in later years enjoy an independent income from insurance.

The two most important features of the Wilson insurance program were (1) that he provided *adequately* for his family, and (2) after providing for immediate expenses he arranged for the insurance money to be paid as *monthly income.*

The figures used in this outline are approximate and necessarily general. Each case calls for its own figures and plans.

POPULAR SCIENCE MONTHLY recommends that you regard your insurance representative as a professional adviser. Let him help you work out your individual problem. More and more insurance is being taken out on this basis. And it pays.

This Book Tells
How You Can Share in Today's Prosperity

Make it the Foundation of Your Financial Independence

You have read and heard a lot about prosperity in America. What does it all mean to you—just a steady job, a little more spending money, a few more luxuries? Or does it mean your opportunity to acquire independent means and an independent income—something permanent and worth while?

As you know, rich men have many opportunities and many ways to invest safely and at the same time make big profits. But you may not realize that you now have the same opportunity. The Investment Trust gives you, with your hundreds, every investment advantage that the rich man has with his millions.

A Tested Plan

The investment trust idea originated in Great Britain over sixty years ago. As a result, canny Scots and conservative Englishmen have been making 15%, 20% and 25% on their money. The same plan is now gaining wide-spread popularity in America.

You can learn all about investment trusts by reading our new booklet. In every-day language it explains what investment trusts are, how they operate and how you can benefit.

Learn How YOU Can Make Big Profits Conservatively

You will learn from this booklet how to invest $100 or more and own a share in over 150 of the world's best securities; how this wide diversification gives you not only extreme safety, but many opportunities for unusual profit; how 10%, 15% and more is made on conservative 5% and 6% investments.

You will learn how an investment trust is managed by men who are experts with every facility at their command; how they *know*, without any guessing, which securities are best to buy and when the best time to buy them.

Take the First Step Today. Make this booklet the beginning of your financial independence. Mail the coupon *now.*

UNITED STATES FISCAL CORPORATION

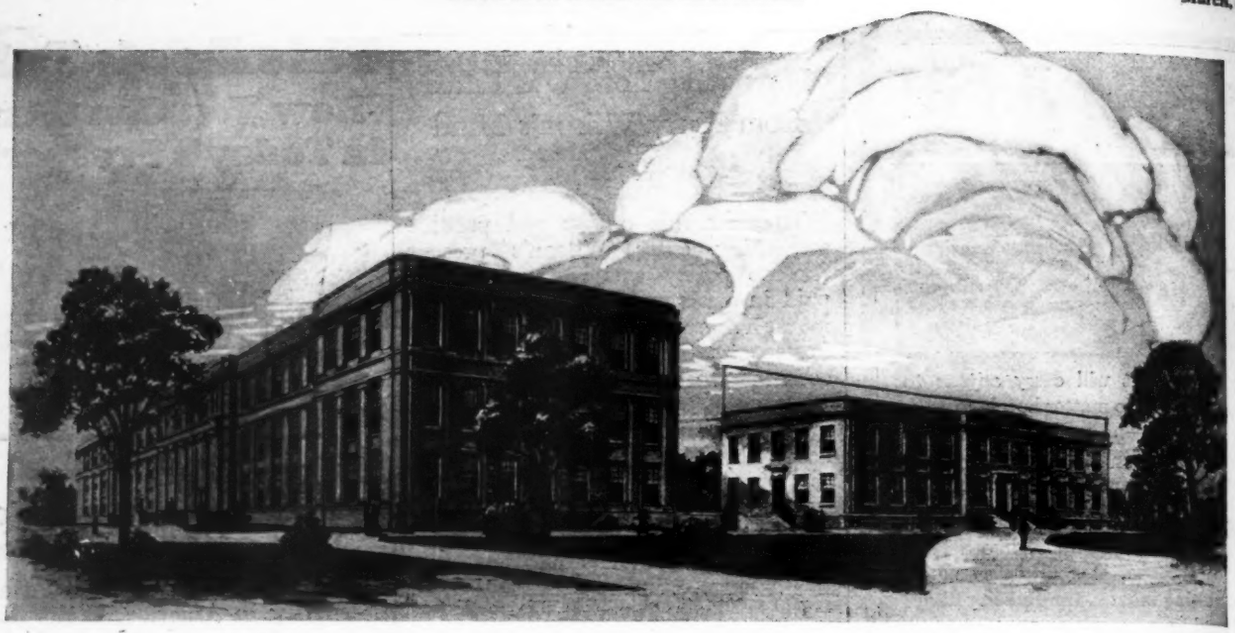
United States Fiscal Corporation
50 Broadway, New York

Please send me, immediately, your free booklet that tells how I can invest for financial independence.

*Name*_____

*Address*_____ 3-P.S.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.



Illustrated above is the proposed engineering group at New York University. The building on the right is already erected and it is here that the tests of the Popular Science Institute are conducted

Deciding What Tools Are *Good*

By
F. G. PRYOR, *Secretary*
Popular Science Institute of Standards

"IT IS a fine tool; it represents good value; it will give you satisfactory service,"—this is what the Popular Science Institute of Standards' insignia of approval tells you when you see it on a tool advertisement. Such statements mean much or little according to what lies in back of them and the tool user will rightfully ask, "How do you know that?"

As a matter of fact, the Institute had no easy task determining this and it took considerable time, work and study before it was felt to be in a position to speak authoritatively on the subject of tools.

In the first place, while the Popular Science Institute was fortunate in having some very prominent engineering experts on its staff and in having at its disposal the $350,000 Sage Research Laboratory testing equipment at New York University, it had little to go by in the matter of test methods and still less in the case of standards.

This meant two things. Test methods had to be worked out and in many cases equipment had to be specially designed for use in making such tests. There are machines like the Rockwell, Brinell and Scleroscope, for instance, that can be used in testing the hardness of the steel in a tool, but when it comes to putting a hammer through a test of so many thousand blows there is no machine that one can go out and purchase for the purpose. So, in a case like this, the Institute's testing experts had to devise an arrangement that would accurately serve, just as it was necessary to rig out an ingenious reciprocating machine that would put an automatic or spiral screw driver through the equivalent of several years of heavy everyday usage in only a few days' time.

Then, an even harder task confronted the Popular Science Institute of Standards when it came to gaging the test results and determining where to draw the line in the matter of approvals. The Institute's testing experts relied upon whatever could be found in Government bureaus and elsewhere, but the difficulty lay in the fact that they were not trying to set up any absolute standard that every tool or product must attain in order to be a good one, but were endeavoring to devise tests to suit the use to which each product is put.

The Popular Science Institute's tests are not perfect yet—not by a great deal—but just how far we have gone and just how worth while the work has been can be judged by the recognition that has come from highest sources.

The U. S. Bureau of Standards in Washington has recently appointed the Institute's director, Dean Collins P. Bliss of New York University, as a consulting mechanical engineer for their organization, and the belief has been expressed by officials of the Federal Specifications Board that the affiliation of the U. S. Bureau of Standards and the Popular Science Institute of Standards will result in mutual help and benefit.

Our Assistant Director in charge of tool testing is Major Carlos deZafra, Chief of the Testing Laboratory Section of the New York Ordnance District. This appointment means that all tools of the U. S. Army will be tested, prior to writing of specifications of purchase, in the Sage Laboratory where the Popular Science Institute's tests are conducted.

These tests are conducted for the benefit of POPULAR SCIENCE MONTHLY readers with no charge nor advertising obligation to manufacturers. A list of approved tools may be had by writing the Popular Science Institute, 250 Fourth Ave., New York, N. Y.

Popular Science Monthly
GUARANTEE

The above seal on an advertisement indicates that the products referred to have been approved after test by the Popular Science Institute of Standards.

POPULAR SCIENCE MONTHLY guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in POPULAR SCIENCE MONTHLY may expect them to give absolute satisfaction under normal and proper use. Our readers in buying these products are guaranteed this satisfaction by POPULAR SCIENCE MONTHLY.

THE PUBLISHERS

Radio is better with *Battery* Power

Why pay for waste space?

Buy the EVEREADY LAYERBILT

—it's every inch a battery

This is the Eveready Layerbilt, the unique "B" battery that contains no waste spaces or materials between the cells; the longest lasting of all Eveready.

IN DRY cell "B" batteries made up of cylindrical cells more than one-third of the space is wasted. That's inevitable. No matter how closely you pack a group of cylinders, there always will be spaces between them. Usually these spaces are filled in with pitch or other substances, to prevent movement of the cells during shipment and breakage of the wires connecting cell to cell. Think of it—over a third of the space inside the ordinary battery is filled with inert packing material!

In the Eveready Layerbilt "B" Battery No. 486 there are no waste spaces between the cells and no useless materials. Instead of cylindrical cells, this extraordinary battery uses *flat* cells. It is built in layers and assembled under pressure into a solid block. Electrical connection between cell and cell is automatic, by pressure of the entire side of each cell against its neighbor.

The most surprising thing about this construction is that it actually makes the active materials more efficient. A given weight of them produces more current, and lasts longer, than the same amount when put in the cylindrical cell form. This was the unexpected result of researches into methods of utilizing the hitherto waste spaces. Scientists now know that the flat shape is the most efficient form for the cells in a "B" battery. No wonder the Eveready Layerbilt is the longest lasting and therefore most economical of all the Evereadys.

Only Eveready makes the Layerbilt. Its exclusive, patented construction is Eveready's greatest contribution to radio enjoyment, giving new economy and convenience to battery users. The Eveready Layerbilt, of course, provides Battery Power—silent, reliable, independent, guarantor of the best reception. For modern sets, use the Eveready Layerbilt.

Illustrated to the left is the cylindrical cell type of "B" battery construction. Note the waste space between the cells.

NATIONAL CARBON CO., INC.
New York UCC San Francisco
Unit of Union Carbide and Carbon Corporation

Tuesday night is Eveready Hour Night
East of the Rockies
9 P. M., Eastern Standard Time
Through WEAF and associated N. B. C. stations
On the Pacific Coast
8 P. M., Pacific Standard Time
Through N. B. C. Pacific Coast network

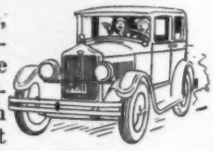
EVEREADY Radio Batteries —they last longer

The air is full of things you shouldn't miss

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Our Readers Say—

What Do You Say, Gus?

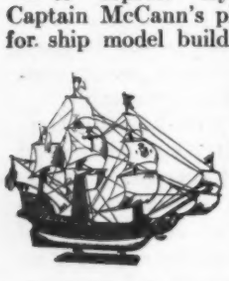


GUS and Joe, those inimitable garage experts who are with us each month, felt justified, a few issues ago, in roundly blaming the woman who "drives" from the back seat. Letters from many readers agreed with them. But listen to Mrs. L. S., of Walton, N. Y.

"Why must the wife sit in the back seat, anyway? From that position everything looks much more dangerous. Since learning to drive I have found that what looks like an unavoidable smash from the back seat does not remotely suggest one to the driver, and very rarely to the other occupant of the front seat. This is just a plea for a square deal for the woman."

A Place of Honor

"PERMIT me to take this opportunity to express my appreciation of Captain McCann's plans and directions for ship model building. Not only are these plans clear and correct in every detail, but they produce beautiful and artistic results. I presented a model of the Spanish galleon to a cousin who, among other gifts, received a new grand piano; and my Spanish galleon now has the place of honor on the piano."—W. C. R., South Pasadena, Calif.



What Hope for Inventors?

"I WAS surprised, recently, to read that Maurice Holland, of the National Research Council, says the independent inventor has seen his best days. Mr. Holland pointed out that less than five percent of the inventions in the Patent Office which receive commercial recognition are the products of men who labor single handed. And he concluded that the 'garret genius,' as he calls him, cannot hope to compete nowadays with the collective work of men in highly organized industrial research laboratories.

"Is this true? I doubt it. Count over the inventions which have given us most of our modern wonders. The telephone, electric light, automobiles, airplanes, wireless, the machinery of farm and factory—every one sprang from the hand of a lone worker, often struggling with poverty, but inspired by a great idea.

"Hired workers in great laboratories are necessary for the application of inventions to industry; but the greatest inventions themselves come from the labors of the 'garret genius.' Am I right?"—N. B. Y., Detroit, Mich.

The Debate Goes On

"PROHIBITION—Is It Good for Us?" in our January issue drew many letters from readers. For example, A. S., of Dwight, North Dakota, writes:

"I have in a most unbiased manner compared and analyzed the indictment of prohibition by Dr. Charles A. L. Reed, and the defense by Dr. Haven Emerson. Dr. Emerson brought forth twenty-nine major reasons why prohibition is a benefit to our nation. For each reason he offered unimpeachable evidence. Dr. Reed, on the other hand, failed to make a point."

And then: "Dr. Reed wins the debate by long odds," observes S. M. T., of Cleveland, Ohio. "Dr. Emerson uses the circumstantial evidence of general mortality rates to show that prohibition is good for us. His whole argument falls before the undisputed direct evidence of increasing deaths from poisonous prohibition liquor. And does he realize how many people are dying for a good drink?"

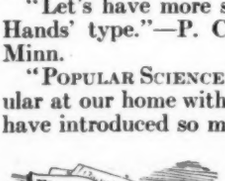
What Do You Think?

"I OBJECT to fiction in your magazine. Leave fiction to others. Some of your articles seem to be pretty good fiction, anyway."—R. T., Lincoln, Neb.

"The stories are interesting, instructive, and make the magazine more enjoyable than ever."—L. A. T., Peoria, Ill.

"Let's have more stories of the 'Bare Hands' type."—P. C. K., Minneapolis, Minn.

"POPULAR SCIENCE is not quite so popular at our home with the boys since you have introduced so much reading matter in the way of stories."—T. E. D., Cleveland, O.



"Your idea of fiction science is excellent, and should prove immensely popular with the reading public."—C. E. R., Toronto, Canada.

"When there is so much bad fiction on the market, why do you have to add to it?"—S. M. T., Fargo, N. D.

"Your story, 'Midge', tells enough about the making of steel so that it holds a person's interest better than many articles could."—H. R., Edgerton, Wis.

Glad You Like It

"I HAVE a free season ticket to the opera, and I go every week.

"I have a clock which I never need to wind, yet it strikes the correct time every day in the year.

"I follow all the ball games and boxing matches free without crashing the gate.

"I go to church every Sunday and never drop a dime into the plate.

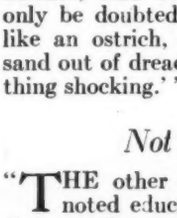
"Every so often the President of the United States tells me his troubles.

"In fact, I am quite a privileged citizen. And all because I built that POPULAR SCIENCE five-tube radio. I must say it has exceeded my fondest hopes."—J. L. M., Pittsburgh, Pa.

Apes and Ostriches

"I AM not a Darwin ape; neither are my friends." writes C. H. of Los Angeles, Calif., one of the readers who commented on Sir Arthur Keith's recent summary in POPULAR SCIENCE MONTHLY of the proofs of Darwinian theory. In the same mail S. L. T. wrote from Nashville, Tenn.:

"Though I live in a state which has a law against the teaching of evolution, the clear explanation of the evidences for evolution contained in your article was convincing enough for me. As Dr. A. A. Noyes, president of the American Association for the Advancement of Science, said recently, 'Evolution can only be doubted by an individual who, like an ostrich, buries his head in the sand out of dread that he may see something shocking.'"



Not Dead Yet

"THE other day Glenn Frank, the noted educator, expressed the fear that modern science, while creating wonders, is killing our capacity for wonder and curiosity—in other words, making the universe all matter-of-fact.

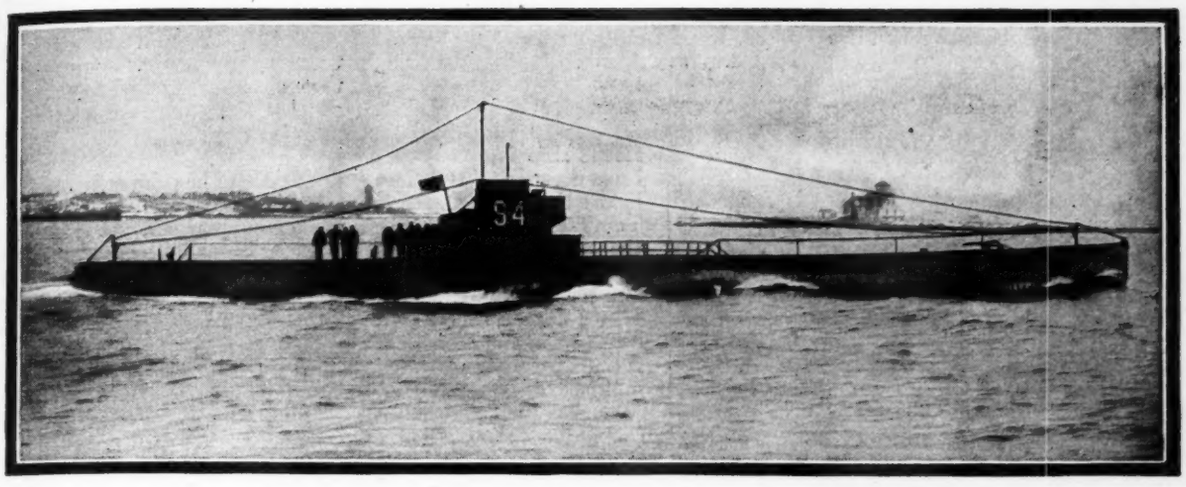
"He never saw my kids and me reading our copy of POPULAR SCIENCE MONTHLY together. Those pictures and stories of the mysterious far-away stars, of great deeds and adventures, of giant buildings and machines, of the magic of electricity and flying machines—all make POPULAR SCIENCE a wonder book that never grows old.

"As for curiosity—well, I'm here to state that the editor of an encyclopedia would faint away if he had to answer all the questions they ask me in one sitting."—M. J. L., St. Louis, Mo.

Popular Science MONTHLY

FOUNDED 1872 — FIFTY-SIXTH YEAR

MARCH, 1928 — SUMNER N. BLOSSOM *Editor* — VOL. 112, NO. 3



Making Submarines Safe

Inventions That Might Have Prevented the Tragic Loss of the Crew of the S-4 That Fought for Life at the Bottom of the Sea

By JOHN WALKER HARRINGTON

IN A gale-swept bay of the New England coast one of the greatest rescue fleets ever mobilized closed about the spot where forty men had been buried in a crushed coffin of steel, flung to the bottom of the sea.

The living tomb was the submarine *S-4*, one of the largest of Uncle Sam's undersea fighting machines, which had been rammed and sunk by the U. S. destroyer *Paulding*.

A sensitive listening instrument on the *S-4*'s sister ship, the *S-8*, caught the sound of sharp rapping on the metal hull of the stricken ship. The *S-8* answered and then the rescue ship *Falcon* with its oscillator took up communication.

The rapping spelled a message in Morse International telegraph code—a pitiful question from six of the men trapped at the bottom of the sea:

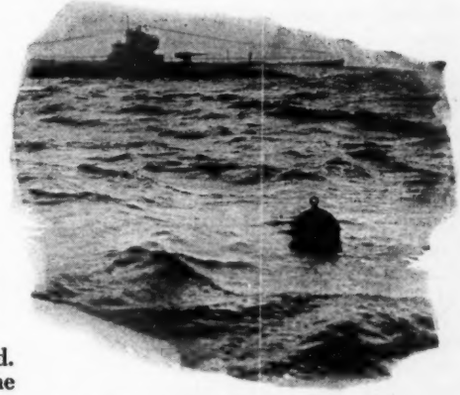
"How long will you be now?"

THE question found no answer; it remains unanswered. Yet from out of the depths where those six brave men perished may yet come a response in new ways for the deliverance of sailors who in the future may face the perils of the underseas.

The *S-4* disaster off Provincetown, Mass., a few weeks ago, following as it did upon similar accidents to submarines, brought to the nation the sharp reminder that although measures to prevent such horrors had been proposed, none had been adopted. This newest catastrophe aroused the American public and its officials to give heed to that query, "How long will you be?" and to demand that the lives of submarine crews be safeguarded in days of peace.

A VESSEL of one thousand tons, the *S-4* was so near like the *S-51* which met a similar fate in 1925, that she might well be called a sister ship. She had been at the Portsmouth Navy Yard, and after slight repairs had been sent on a testing cruise before being overhauled. She was rising from a dive when the *U. S. S. Paulding*, one of the swiftest vessels in the world, came cutting the wintry sea at eighteen knots, a little more than half speed. Suddenly the helmsman of the destroyer caught sight of a slender object, the submarine's periscope emerging. A stake of fishermen's nets, he thought.

He changed his course, rang for full speed ahead, thinking only to keep the propellers of the *Paulding* from being fouled by the obstacle. Too late! The conning tower of the *S-4* lifted in sight.



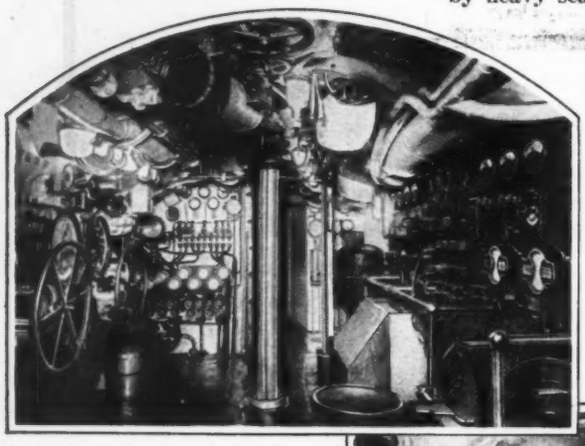
Buoy marking spot where S-4 sank and sister ship, the S-8 signalling with her oscillating device to doomed crew. Above: The lost vessel

The *Paulding* struck—a blow so terrific that her own bow rose high out of the water—crumpling the tower like a shell and tearing a gaping hole in the starboard side of the submarine's battery room. Almost instantly the *S-4* filled and went down by the head into the gray ooze of the Atlantic floor.

JUST what happened aboard the doomed vessel during those few desperate moments none will ever know. But from the record of code messages exchanged between the rescuers and the doomed men it is not hard to imagine the scene. A seaman in the tower, gazing through glazed portholes to report the first glimpse of green surface, is killed outright at the collapse of his sentry box. The waters, pouring through the gaping wound in the vessel's side, roar into the battery room. Brine-flooded cells of the storage batteries

send forth stifling chlorine fumes. Swirling torrents sweep into the control room—the brains of the ship just under the conning tower—overwhelming seamen at their stations before wheel and valve.

A few struggling men seek refuge in the stern or in the motor compartment, wading waist high in the flood in a vain attempt to close a bulkhead door. Six men, a lieutenant, three torpedo men and two seamen, gain the forward torpedo room, and are safe, for a time, in this steel-girt prison cell—a bubble of air twenty-three feet long, ten wide and seven high.



Central control room of the *S-4*. Among these instruments—an ironic symbol of the power of man over the forces of nature—some of the men of the submarine perished with many would-be rescuers close by

What thoughts come first to the minds of these six? Not such as a landsman might think, for these are men whose every day is a hazard. The fate of the *S-51* flashes before them. One chance in a thousand to be saved! But they are fighters all, and they will fight to the end for that chance.

Now the nerves of the *S-4* cease to throb. Her lights fade. Her heart is stilled. Heat dies away and the narrow chamber grows as cold as the water that presses against its walls. With blankets taken from the shelflike beds, the shivering men fight off the tomblike chill. Scant emergency rations are doled out. Water seeps in, covering the floor of their black prison. The air they breathe grows stale and will soon be poison, but they pin their hope on five small steel cylinders of condensed oxygen to keep life in their bodies until aid comes from they know not where. Saving their energy, they breathe as lightly as they can—and wait through hours that seem days. In their minds—for speech wastes breath—they turn over and over again the chances of coming out alive.

MEANWHILE the world above is alive with activity. The *Paulding*, having thrown a buoy to mark the place where the submarine went down, and having sent lifeboats to search—vainly—for survivors, has limped to Provincetown to report the collision. Telephone and telegraph spread the news to Washington, to the Navy yards, to the submarine base at New London, Conn. Salvage experts in New York, Boston, Norfolk, hurry by fast trains, by automobiles, even by hydroplane. Crack divers, eager volunteers, hurry to the scene.

BUT how slowly come the salvage vessels. What ages the hours have seemed to the six captives in the torpedo room, while twenty-six vessels, battered by heavy seas, can do nothing to bring them hope!

Twenty-four hours pass. A diver descends from the rescue ship *Falcon* to the broken wreck, 101 feet below the surface. He is Tom Eadie, swathed three times in wool under his waterproof diving suit. To him comes a faint sound. Is it only the echo of his own leaden tread, or does it come from the shattered hulk? Whirling a hammer, he strikes the steel shell a resounding blow. There comes back an answering rap. He telephones from his copper helmet to the *Falcon:*

"There is life aboard!"

Then the *Falcon* above, using an oscillator for communication, begins an exchange of tapping messages in Morse code—a quick tap for a dot, two taps for a dash.

"Is there any gas?"

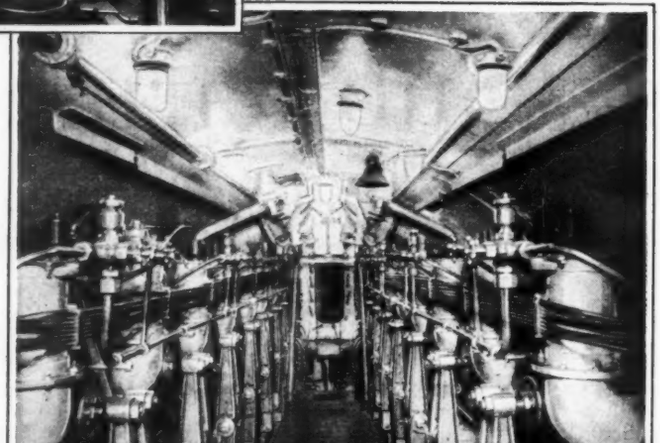
"No," is the steady answer, "but the air is bad. How long will you be now?"

"How many are there?"

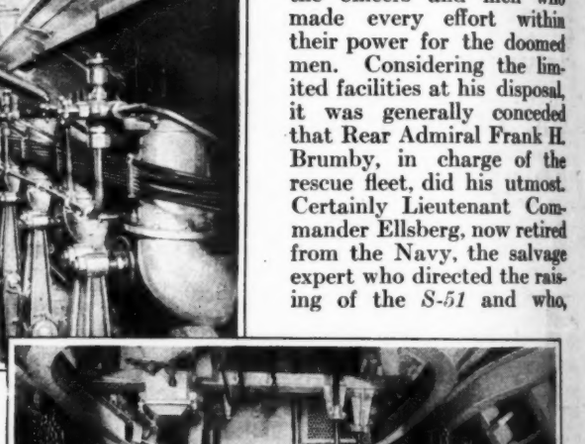
"There are six. Please hurry! Will you raise us soon?"

"Everything possible is being done," is the reply.

"Good God!" we can hear them say. "Everything possible! *Is* anything possible? Have we a chance?" They think of the *S-51*, cut down by the S. S. *City of Rome* off Block Island in 1925 and raised with her thirty-three dead nine months later. American submersibles have no outside fastenings to provide holds for lifting chains or cables. The only method possible now, as with the *S-51*, is lifting by pontoons. Divers with air guns must blow tunnels under the hulk. At this writing none had been able to do that in the silt of Provincetown, although three had nearly died in the attempt. Once tunnels are made, chains are passed through and attached to pontoons which can lift the wreck—a long and tedious process at best.



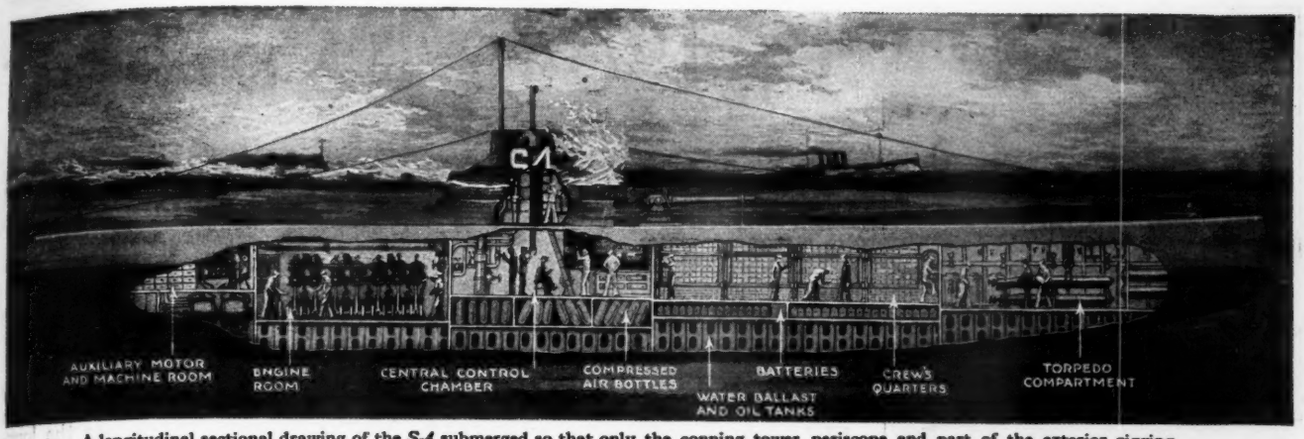
Engine room of doomed *S-4*. Here others of the submarine's officers and crew were trapped hopelessly when the crash no machinery could resist sent her to the bottom



View of aft end of the *S-4*'s torpedo room, showing the four torpedo tubes in the middle of the photograph. From these quarters six of the crew signalled for 3 days that they still lived

SCIENCE has done much to provide the means of life for the crews of sunken submarines, yet that much is far from enough. Their own resources crippled, the trapped men had only the five bottles of oxygen to keep them alive until the promise of rescue was made good. The last bottle gave out on the third day, as they tapped in one of the last piteous pleas for help. Then the tapping signals grew fainter, and finally ceased. They had perished.

The tragedy brought a flood of criticisms of the Navy Department for failing to provide better means of rescue. Even the harshest critics, however, have praised the officers and men who made every effort within their power for the doomed men. Considering the limited facilities at his disposal, it was generally conceded that Rear Admiral Frank H. Brumby, in charge of the rescue fleet, did his utmost. Certainly Lieutenant Commander Ellsberg, now retired from the Navy, the salvage expert who directed the raising of the *S-51* and who, volunteering his services anew, nearly lost his life in diving about the wreck, is deserving only of honor. The heroism of the divers seemed superhuman. Among those who think so is U. S. Representative Anthony J. Griffin of New York, who introduced a resolution asking for a Congressional inquiry of the whole



A longitudinal sectional drawing of the *S-4* submerged so that only the conning tower, periscope and part of the exterior rigging rises above the surface. The artist has shown all the interior, including the torpedo compartment, where life was last known to exist

subject of safety for submarine crews with special reference to the loss of the *S-4*. He moved in vain for a similar inquiry when the *S-51* was sunk.

Representative Griffin is an engineer and has invented several submarine safety appliances, which he has offered to the Government. He and others have proposed that eyelets by which the vessels may be lifted be attached to all submarines. By fastening such rings to bands welded to the hulls Mr. Griffin believes they would be entirely practicable.

Mr. Griffin also is the inventor of a life raft or chamber designed to fit into the superstructure of a submarine between the deck and the hull. In case of accident the crew could enter this chamber from below through a hatch and set it free by releasing a pinion. The device, containing air cells, would be buoyant enough to rise to the surface.

Some of the newer types of submarines have air locks connected with the conning towers, from which the men can emerge when the vessel is badly injured. Under some conditions torpedo tubes may serve as emergency exits. Owing to heavy pressure of water at such a depth as that to which the *S-4* sank, the crews in such escapes would need diving helmets and protection for their chests. For such purposes light diving suits, fitted with small oxygen reservoirs and air purifying devices, are in use in the German, Dutch, Danish, Swedish and Spanish navies.

AN INGENIOUS escape compartment designed by Simon Lake, inventor of submarines, has proved practicable. Men who are about to leave the vessel first enter this room into which several atmospheres of compressed air are forced. When the proper quantity has been injected a hatch cover in the bottom can be opened and the sea water, rising only a little in the well, is kept in check by the pressure of the air, allowing escape through the hatch. Since help must be prompt, a signal buoy, which can be released from its housing on the deck of a sunken submarine and remains anchored to the distressed vessel is standard equipment in several navies. In addition, a telephone wire running from an instrument in the floating buoy to the interior of the submarine provides ready communication.

BETTER methods of connecting air lines to a disabled submarine are demanded. Instead of only one inlet, leading to the interior air system of the vessel, an inlet for each compartment has been urged. Not only could fresh air be pumped in through these, but coffee and liquid foods.

The undersea tragedies of the last few years have shown that the American Navy does not own salvage vessels and pontoons large enough for speedy rescue of large submarines. In the German and Italian navies are super-salvage vessels ready to go where the government requires them. A German salvage ship, the *Vulcan*, which raised the *U-3* at Kiel in 1911, can lift the largest types of submarines with ease. She consists of two hulls, which are really huge pontoons that can be lowered or raised by admitting or releasing water ballast, as does a submersible. The sections are joined together by a heavy steel bridge on which powerful cranes are mounted.

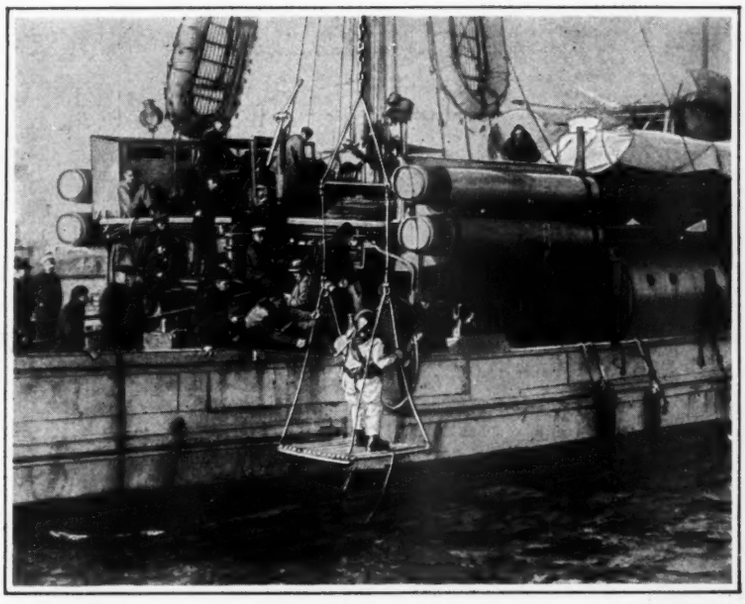
IT IS estimated that effective salvage vessels of this type could be built in the United States for $1,500,000 each. Even at a higher figure, their use would seem to be justified, for large submarines cost about $3,000,000 apiece, and carry gallant men.

Representative Griffin has suggested that many of the Shipping Board vessels, now moored in out-of-way places, might well be converted into salvage outfits similar to the *Vulcan* by joining two of them catamaran fashion. Adequate equipment of all kinds should be built and ready to respond when the need arises, not made "to order."

HOW little prepared the Government has been for such disasters was illustrated in the now almost forgotten loss of the submarine *F-4* near Honolulu. Since no salvage vessel was available, one was made up from two scows and a crane, requiring three weeks labor. Then it failed. So expert divers were summoned from the Brooklyn Navy Yard, 5000 miles away; and pontoons were built in San Francisco and shipped on a cruiser. The *F-4* was raised at last—with the bodies of its crew of twenty-one.

Definite action toward greater safety now seems pretty well assured. In addition to the formal Navy Board of Inquiry, and a Congressional investigation into the *S-4* disaster, Secretary of the Navy Wilbur has announced he will ask a commission composed of both naval officers and civilians to study the situation.

Possibly never before have the American people become so aroused over a naval disaster. If the lesson serves to safeguard the lives of middies of the undersea in the future, the gallant crew of the *S-4* will not have perished in vain.



Diver Wickwire, being lowered from the rescue ship *Falcon* in one of the efforts to pierce the shell of the *S-4* in such a way as to carry life-saving air to her valiant crew without admitting at the same time water that would instantly cause their deaths

Is Lost Explorer Now Jungle God?

By FRANCIS GOW SMITH

Col. P. H. Fawcett, of whose party nothing has been heard since he and his son and a friend entered Brazilian jungle three years ago

"CUYABA, Brazil.—Freed from romantic captivity as the living idol of a remote Indian tribe hitherto unknown to science, Col. P. H. Fawcett, the noted British explorer who in 1925 vanished into the jungles of Matto Grosso, is now being brought out to civilization.

"Messages from Commander Dyott, leader of the Fawcett relief expedition, indicate the rescue was accomplished by a clever raid upon the savages' village in which airplane and overland party coöperated."

WITHIN the next eighteen months I expect to read a news despatch worded much as above. It will mark the climax of an adventure rivaling the most sensational exploring feat of the last half century.

In 1871, the world waited breathless while Henry M. Stanley fought his way hundreds of miles through equatorial Africa to rescue the long lost Scottish missionary, Dr. David Livingstone. Today, Commander George M. Dyott, explorer and lecturer, has set forth on an even more daring mission—to wring from the jungles of Brazil some clue to the mysterious fate of the vanished British war veteran, Lieut. Col. P. H. Fawcett, D.S.O.

After a life dedicated chiefly to South American exploration—as Livingstone's was dedicated to discoveries in Africa—Col. Fawcett undertook, three years ago, to survey and map the least-known fastnesses of Matto Grosso. At the age of fifty-eight, accompanied only by his son Jack and one other white companion, he plunged northward from Cuyaba into the wilderness—and he has not been heard of since except through romantic rumors that only increase the mystery of his disappearance.

COMMANDER DYOTT is a fellow Englishman who has already made two spectacular trips through the heart of South America—one over the Andes from the Pacific and down the Amazon; the other last year along Roosevelt's trail and down the River of Doubt. But this time Commander Dyott, financed as Stanley was by American capital, must penetrate a gloomy wilderness more forbidding than he has formerly traversed, and even less known than Africa was when it swallowed up Livingstone; and Dyott in Brazil will have no such clues as helped Stanley on his historic quest.

The name of Henry M. Stanley fifty years ago was a synonym for daring adventure. After exploits on both sides in the Civil War, he was commissioned by James Gordon Bennett of the *New York Herald* to find Dr. Livingstone, who in 1865 had set out to discover the long-sought sources of the Nile and for nearly seven years had not been heard of.

Stanley, leading 200 men inland from Zanzibar through the densest of African jungles, soon began to get word from the natives of a strange, bearded white man lying ill and helpless at the slave-trading town of Ujiji, on Lake Tanganyika. And there, on November 10, 1871, Stanley, exhausted by his eight months of hardship, had no words to greet the venerable missionary but these, "Dr. Livingstone, I presume?"—which still echo in the pages of history.

But Commander Dyott is faced by the apparently insurmountable task of locating three solitary exiles somewhere in 350,000 square miles of trackless jungle—which Col. Fawcett called the last great blind spot on the habitable globe. It is greater in extent than the combined states of Ohio, Illinois, Indiana, Iowa, Missouri and Michigan. Native frontiersmen fear to cross its fringes, beyond which roam perhaps half a million naked Indians, some of whom have never outgrown the stone age.

IT IS true that Col. Fawcett has been for years at home in just such country. A British artillery officer who served during his youth in Ceylon, Malta, China and Morocco, he was lent by his government in 1906 to Bolivia to act as boundary commissioner. Having helped clear up the disputed line between Bolivia and Peru, he gave himself up to Brazilian

Francis Gow Smith near River of Death, Bororo. Above: Indians near Tapirapuann, savages of the type Col. Fawcett believed himself able to get on with in entire safety. Right: Bororo Indians, typical of the tribesmen Col. Fawcett must have encountered traversing the wild and forbidding region of the River of Death

FAMOUS authority on Brazil offers here an amazing explanation of the mysterious disappearance of Col. Fawcett, British adventurer, who is now being sought by rescuers in the South American wilderness

exploration until the World War, in which he brilliantly commanded a brigade of field artillery.

In 1925, backed by American newspapers and the British Royal Geographical Society, he plunged on his present venture with only his son Jack and one friend, Raleigh Rimmell, to accompany him.

Where Fawcett and his party vanished. His possible adventures are pictured in the accompanying article by an expert who has penetrated the wilderness

BESIDES mapping unknown territories in the neighborhood of the Paranatinga and Tapajos Rivers, his plan was to seek the remains of an ancient civilization, antedating Egypt's. But Brazilians in Matto Grosso who were among the last to discuss his plans with him tell me and I believe that the Colonel's real intention was to discover the fabulously rich lost Gold Mine of the Martyrs—unworked for two centuries since its early Portuguese discoverers were murdered by their Indian slaves—which is supposed to be somewhere north of the River of Death, between the Xingu and the Araguaya.

NOW in the late spring of 1925 Colonel Fawcett sent back by messenger his last report, and it showed him veering toward that region. In a month's arduous travel northward from Cuyaba, he had reached the domain of the Bakairi Indians. His two native *camaradas*, dreading the savages ahead, were about to leave him. Raleigh Rimmell was infected from an insect sting and the pack train of fourteen unruly animals was causing infinite trouble.

Since then, nearly three years of utter silence. And as Commander Dyott sets out, the question arises whether Col. Fawcett is still alive.

A French engineer, Roger Courteville, was reported to have found Fawcett living as a hermit in a "jungle paradise" a hundred miles from Cuyaba, but this report has been thoroughly discredited. Another English explorer, Captain Alfred Henry Morris, later visited the same territory, hunting Fawcett, and found not a trace of him.

FROM my own practical experience in the region I have reached certain conclusions as to his fate.

I believe Col. Fawcett is still alive, and when I say that he is today probably the captive tribal divinity of a band of savages, I am supported not only by my own experiences but by historical and ethnological data and by the opinions of Brazilian frontiersmen with whom I talked less than a year ago.

Mrs. Fawcett, the Colonel's wife, who has been living at St. Malo, France, says telepathic messages from him convince her he is alive and she has said:

"I believe my husband is the prisoner of some tribe of Indians who are treating him well because of their superstitious awe of his powers. Curiously, Commander Dyott's own experiences have been similar. He was once missing for months—all that time being kept prisoner by Indians. Col. Fawcett will yet be found."

Commander George M. Dyott, himself an experienced explorer of Brazil, who is setting out into the wilderness to find his lost fellow explorer and compatriot, Col. P. H. Fawcett

From Col. Fawcett's last letters the Royal Geographical Society's experts deduce that the explorer had altered his originally announced plans and, having reached the Rio São Manoel, tributary of the Tapajos, was swinging northeastward. It seems certain that he had hit on the plan of traveling overland, south of the tenth parallel, along a route that would have brought him to the Araguaya River. And this route would take him directly through the traditional region of the Martyrs' Gold Mine.

NOW had Colonel Fawcett continued northward toward the Amazon between the Xingu and Tapajos Rivers, he would have run into the hands of the Mundurucus, who are industrious headhunters. Or, had he sought to avoid them by descending (*Continued on page 139*)

Left: Semicivilized Indians northwest of Cuyaba, more hostile than the uncivilized ones of the interior. Above: Indians near Rio Tapagos showing in pantomime how they killed members of a government Indian commission. Afterward their arms were taken away. Right: A Bororo behind a tree, luring a bird by imitating its cry to kill it

"A climbing fool!". Cheese shouted from where he was squatting beside Jack and the girl. "She's what I call a rocket, and nothing else but!"

All Metal

By ANDREW A. CAFFREY

What Happened When the Big Air Liner Took Its First Trip—A Story of Ingenuity, Parachutes—and a Girl

JUST mention all metal aircraft construction and you are sure to start some sort of argument. But ask for the best all metal pilot in the game, and the flying world points him out—Jack Page. This yarn has to do with an all metal combination—Jack and his all metal airliner, the *Pacific Gull*.

The three-engined, ten-passenger flying cruiser—the *Pacific Gull*—was the first multimotored superplane to attempt seriously to ply the air as a common carrier between Los Angeles and San Francisco. But the *Pacific Gull's* career was brief, epic and brave. Like so many other pioneering tries, the log of the *Gull* goes unsung, and unremembered save by a possible ten. The ten passengers and two others—Pilot Jack Page and his worthy flying mechanic, "Cheese" Farling.

Pilot Jack Page was the owner, designer and builder of the great craft, which was Jack's oldest and best dream come true. More than a year's hard work had gone into the construction. Jack, Cheese and half a dozen others had done the sweating. How Jack promoted the cash—she cost upward of sixty thousand dollars—no one knows. But, from here and there, the money came; and the plane had taken shape. Great shape, too.

Every truss that went into the *Gull* was hand-picked and tested by Jack. Every yard of dural was the best. All fittings were hand-sawed from cold-rolled stock, ample, reinforced and A-1 pieces of workmanship. Jack Page squeezed the old brain dry trying to make things right. That was Jack every time—air-sized and air-wise in the exacting things of airways. He was big in every way possible; big in the boots from which he towered; and big in his handling of a tough game—air.

So he gave something worthy to the air when he trundled the *Pacific Gull* out for its first hop. And the aeronautical world realized that Jack and coworkers had sounded a new note in aviation. The job was good!

The big craft was of orthodox biplane design. It had a wing spread of eighty-five feet, the top of the upper plane was about two stories aloft, and its overall length would make the average big plane appear stubbed. The ten-place, glassed-in cabin was luxuriously appointed and entirely protected the voyagers from any contact with the elements. Behind and above, side by side and in the open, were the pilot's and flying mechanic's seats. For psychological effect, Jack Page had arranged this cockpit's segregation; if the passengers were unable to watch the pilot, in the event of anxious moments, they—the passengers—would never guess that anything was amiss. A stepdown and short gangway connected this rear control pit with the main saloon.

Each of the ten seats of this fuselage cabin was boothlike—pretty much after the design of a Ferris wheel's caged cars. To become seated, the passenger stepped down from a narrow cat walk which centered the compartment. The brief dropoff made one feel that the legs were hanging through the floor, and maybe they were. When in the seat, the side cushions came just about shoulder-high. Comfortable, that's what it was.

This new seating idea was one of many other important innovations. But Jack Page, always short on talk, allowed them to go unmentioned. And it was these unmentioned things—surprise parts—that, as was noted before, the ten passengers will never forget. No, never! Yet—and make note—Page never "lost" a fare.

THE powering of the great *Pacific Gull* was unique in that two types of motors were used. On each lower wing, at the first interplane struts, was a power nacelle hiding a cowled-in Wright engine of one hundred and eighty horsepower. These two motors were worked as "pushers," that is, with the propeller behind the trailing-edge of the wing. The third power unit, the central motor in the nose of the fuselage, was a Liberty "12" of four hundred and fifty horsepower. In all, the *Gull* had upward of eight hundred measures of that much-desired stuff—horsepower.

The big Liberty engine was solidly bedded on a four-pronged tubular carrier that was firmly bolted—each of the four prongs with a large drift pin—to the fire-shield bulkhead which was the nose of the fuselage. It was a fine mounting. Simply remove two drift wires and drive back four pins and, hooking a block and tackle to the whole works, out came the heavy power unit—motor, water radiator, oil tanks and all. From a point of efficient field service you couldn't beat it; and Jack Page, saying

little about the installation, took great silent pride in this piece of clean-cut engineering. The mention of this motor mount is important!

On the morning of the *Pacific Gull's* first scheduled Los Angeles-San Francisco flight, the first passenger to arrive was plural. It was a man and wife wherein the man was irrelevant. And, at first, you didn't see him, but, on second thought, you knew that all those hand bags weren't carrying themselves.

"Where do we sit?" the lady demanded, and waved two good one-way tickets.

Cheese Farling—he was doing the seating—waited till he got a good look at the man before making answer. "About ninety pounds wringing wet," Cheese speculated under his breath. "And she," he thought, "does not weigh much more. . . .

"IN THE two rear seats, madam," Cheese said.

"But the front seats," said the lady, "they're empty; why can't we have them?"

Cheese was just about to pull that old gag, to wit: that both ends of the plane arrive at the same time. But Jack Page, knowing how to handle women, came to the front and explained that a ship must be loaded in such a way as to best favor its longitudinal balance, and insofar as the plane's center of gravity always falls somewhere in the wing bay, there too should the craft's load be carried. In the matter of passenger loading—stubs and thins to the rear; fats and oversized to the front. The lady understood perfectly.

"But my brothers," she said, "where are they?"

"Now there's a hot one!" Cheese exclaimed, inwardly, as he listened. "Where are her brothers?"

"What do you mean, madam?" Jack asked. "Did you expect your brothers to see you off?"

"NO, NO, NO! My brothers are going, too. They bought their tickets when I got ours."

"There's half an hour yet," Jack informed the agitated one, "and no doubt they'll be on the next bus."

"You'll seat them next to us?"

"Yes, madam."

"When do we depart? When will we be in San Francisco? How far is it to Frisco? How long does it take to get there? Will we be there before the steamship *Hilo* arrives from the Islands? Will we? We must. My sister and her family are on the *Hilo*."

"When is the *Hilo* due?" Jack inquired.

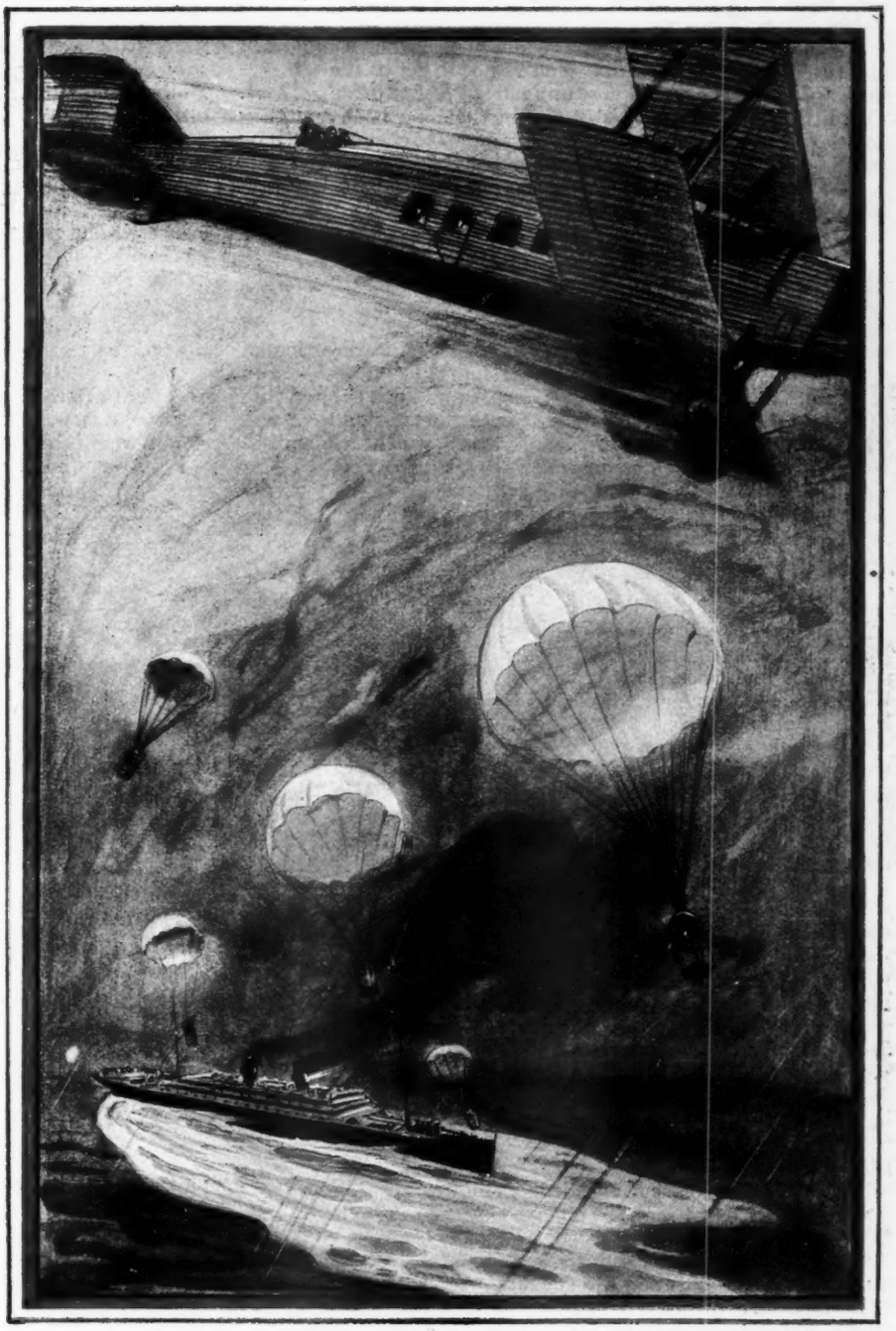
"This afternoon," the lady told him. "According to the company's Los Angeles office, the *Hilo* was two hundred miles off shore at six o'clock this morning. . . . .Will you promise to get me to the *Hilo*? We must be there when she docks, to meet my sister."

"I'll get you to the *Hilo*," Jack Page promised in perfectly good faith.

Just as this conversation terminated, the two brothers arrived and lined up with the luggage-carrying husband. Cheese stowed all hand baggage in the tail-bay compartment, and marched the three boys into the plane.

The next four passengers came in a body; all men, on duty bent. They were government agents of the Bureau of Agriculture.

"When do we get into Frisco?" the chief asked.



The plane circled down over the *Tokio*. Already the big liner had sighted the five parachutes and —judging by the white foam along her sides—had reversed her screws and was standing by

"Take off at eleven," Jack said, "and arrive at three; four hours all told."

"If you make it by three," said the chief, "that will be jake! We've got to be there when the *Tokio Maru* makes port. She's loaded with silk, you know, and we've got a big job ahead of us—a new silk bug has been coming in from the Orient. Another plant pest. The *Tokio Maru* was three hundred miles off shore early this morning, or late last night. She's fast. You're sure we'll get her before quarantine?"

"Easy!" Jack cheered.

MORE luggage was packed away in the box behind the pilot's cockpit and the four government men took their seats.

Then the last two voyagers stepped from a taxi, came through the ropes, and dropped their bags at Cheese's feet. These two, a large man and a small girl—small but oh, boy!—were openly excited.

"Just got under the wire, eh, Sis?" the big man grinned as he dug up his tickets.

"Bet we did, Dad," the girl answered. "And if we missed

this, we'd miss the *Tokio*." See—two more running for the *Tokio*.

"When do we make Frisco?" the father asked as Jack forced him through the small door. "You've got to get us there before the *Tokio Maru* shoves her nose up against *The Embarcadero*. . . . This little girl's ma and sister are on that Jap boat and they don't expect us. . . . And if you don't get us to them—well, boy, your insurance is the best thing you ever did."

"I'll put you right down on her nose," Jack laughed. "You and the young lady will sit up front."

"With the pilot?" the girl exclaimed and enthused.

"NO," JACK smiled. "On this plane, the pilot rides the tail."

"But I've always wanted to ride with the engineer," the girl recited. And, presently, she was moving in the direction of desire. When the American girl wills, she will!

"Sure," the fat old boy said as Cheese and Jack showed him to his tight-fitting seat, "let Sis ride with the pilot on the tail." Cheese busily readjusted the safety belt which fell several inches short of circumnavigating the fat one's equator—"What do I want this belly-band for anyway?" the big man finally asked. "Boys, you're not going to loop this flying hangar, are you?"

"Just an ordinary precaution, Mr. Deuss."—Jack had quickly robbed the name from the tickets which he still held, and, also, noted that the girl's name was Almira Deuss.

"Are all these people trussed up too?" Mr. Deuss asked and laughingly looked about. He discovered that they were. "O.K., boys, tie me tight! . . . And how about it—can Sis ride the tail?"

"It's jake with me," Cheese agreed. "I don't need a seat." Almira—Cheese knew—was not the kind to be in anybody's way.

"It's settled, Mr. Deuss," Jack consented. "I'll show your daughter how it's done." Jack didn't mind if she was in the way.

"Thanks," Mr. Deuss smiled; "but you flatter yourself, boy. Before you're in the air five minutes, she'll be showing you how it *should* be done! Then we *will* need these here form-fitting girdles!"

To cut loose the big motor was a daring plan, never before attempted . . . Cheese moved across the wing and loosened the second drift wire

Illustrations by Clayton Knight

From passenger to passenger, working aft, Jack and Cheese moved and inspected their safety belts. Also they made certain that the aisle door of each small booth was firmly closed. Then they were ready to shove off and Jack moved back and up to his controls. Cheese went overside to assist the ground crew with the starting of the motors.

ONE by one, the side motors barked into action, then settled down to their warming-up purr; and with a bang, the Liberty came to life, howled for a moment, then fell to "cuttin' 'em off" as only a well-behaved Liberty can do. A cloud of dust paraded back to the rear, the crowd of spectators gave way, and the *Pacific Gull* was a throbbing thing of splendid life.

While the motors warmed, Jack called Cheese to the cockpit and pointed to his instrument-board compass.

"Look at it!" Jack exclaimed. "The darned thing is sure gyrating like a merry-go-round, eh?"

Cheese watched the dancing compass float. "She's sure haywire, but what can you do?"

"Not a thing," Jack resigned. "But it gets my goat! One minute your compass is in perfect orientation, and the next minute the motor generators have turned it into a pinwheel. . . . Hold onto everything; I'm going to give these motors a run."

For thirty seconds the three motors, at top speed, made the world awful with their combined roar, then, slowly, Jack closed the throttles and the power units fell to a muffled silence once more.

"Pull the blocks!" Cheese yelled, and climbed aboard. The ground crew removed the wheel chocks, warned back the crowd, the motors sent up their wail again, and the *Pacific Gull* lifted its tail and was gone.

Getting off the ground, Pilot Jack "poked" his ship's nose at Hollywood and the hills beyond, to the north. The craft made altitude easily.

"A climbing fool!" Cheese shouted from where he was squatting beside Jack and the girl. "She's what I call a rocket, and nothing else but!"

"It looks like heavy going ahead for the rocket," Jack answered and pointed to cloud banks far afront. "Pray a little, Cheese."

The *Pacific Gull* was in clouds before she had lost sight of Hollywood. And those clouds were getting heavier every minute. They seemed to be heaviest inland, so Jack eased off toward the sea.

"I'll have to work along the coast," Jack yelled. "We'll cut over Santa Barbara and keep just west of the ridge."

The coast was picked up a little south of Ventura, but the clouds were heavy as ever. Visibility over the Pacific was very poor, and the mountains—now all at their right hand—were carrying the black sky on their tops. But they had the water below and could sneak along under the hard going, and, for the time being, things were not too bad. Not too bad, but bad enough. The *Pacific Gull's* first hop wasn't going to be all joy. And Jack Page was holding that ship "in his lap" and silently cussing one bad compass that he was going to need, and need badly.

BEYOND Santa Barbara a pall of black drapery fell over the *Gull* and sent out shapeless arms of sinister omen. Beyond, right over her nose, the sea fog came up, and, in that gray-green mess, three propellers cut their whirling disks of white. Below, the sea had also gone out. And Jack Page drew the big ship a little closer to him.

Now, with all earthly marks gone, Jack flew entirely by altimeter and instinct. He held an altitude of three hundred feet, tried to visualize the lay of the shore, at his right, and ever and ever gave way to the left. He knew that the open sea was better than mountains. Anyway, this fog could not last long. Rain was falling now, perhaps she'd clear.

But the thick going did last. One hour payed out, and another. By that time, the *Pacific Gull* was in a sad plight: Jack Page—without the aid of a compass—was lost. But, when lost—you fight!

The cabin passengers also realized that all was not well. At first, Cheese had tried to tell the back-seat four that the cloud effect was only smoke from burning rubbish; but he couldn't make it stick. Mr. Deuss and the four government men silently tapped the arm rests of their snug booths and stared out the side windows.

"Everything will be jake," Cheese told them. "We've got gasoline enough for three hours more. Long before the end of that time, we'll ride out of this stuff." This was a reasonable hope.

"Yes, but where?" Jack asked himself as he listened to Cheese's voice come up the companionway. . . . "You afraid?" he asked the girl.

"Do I look it?" she smiled back.

"No." As he spoke, Jack studied her face. And knew.

"Well, that's the correct answer, Jack Page. Lead on!"

THE Pacific Coast, from Los Angeles through Santa Barbara to Point Pedernales, runs nearly due west for one hundred and fifty miles. But at that point—Point Pedernales—the mainland quits its westward push and the shoreline points almost straight north to San Francisco, two hundred and sixty miles away. So, at the end of his second *(Continued on page 156)*

Why We Are Immune to Some Diseases

How Tiny Bodies in the Blood Protect Some Men Against Illnesses That Others Cannot Survive

By
LIDDA KAY

FOUR men of Buffalo, returning some years ago from a convention in a neighboring city, were stricken with typhoid. The infection was traced to the water they had drunk in the convention city.

Why was a fifth Buffalo man who drank the same water apparently immune to the onslaughts of the typhoid bacteria? And why had all but a few residents of the convention city been able to drink the poison-laden water with impunity for weeks, possibly months?

In the answers lie the results of some of the most important discoveries in the history of medicine, as well as of a series of amazing experiments dating from Pasteur's inoculation of hens with old cholera germs. They go far toward explaining why we contract the diseases we do, as well as those instances of apparently miraculous escape.

Two men using a public telephone receive influenza germs deposited there by a previous patron. One develops the disease, the other doesn't. Three children in a family come down with measles; the fourth is immune.

Such instances can be multiplied indefinitely. The phenomena of natural immunity have been observed for centuries. Yet only recently—since the establishment of the bacterial origin of disease—have any workable explanations been offered. The discovery of ways to make us artificially immune was the next step. Some day, the doctors tell us, they will have found vaccines and serums to immunize us all to all diseases of bacterial origin. The family doctor of the future will be an immunologist.

Their theory is this:

In our bodies are countless armies of tiny chemical substances called antibodies—our chief front-line fighting force against disease. Each antibody has its own particular antigen, or substance for which it has a chemical affinity. Any disease germ is an antigen for a certain antibody, and if each invading germ finds its particular antibody in our bodies a battle ensues, the antibody destroys the germ, and we ourselves do not even know that we have won a victory.

Your body may at this moment be well

Above: Boston school children ready to receive the Schick test for diphtheria. If slight injection of the disease toxin causes inflammation, one is susceptible. Middle: A child receiving injection for test. Below: Preparing diphtheria toxin to test immunity. Scarlet fever and smallpox toxins also are made to test immunity against these diseases

fortified with diphtheria antibodies and have none at all of value against typhoid. Consequently the diphtheria bacilli are met and conquered before they can gain a foothold, and you are "immune" to diphtheria. Your hope against typhoid would be in the speed with which, once you were taken ill, your body *created* enough antibodies to destroy the typhoid bacteria.

The Buffalo man who escaped had sufficient typhoid antibodies. Residents of the affected city had apparently been able to develop immunity through the growth of antibodies in their blood, on a city-wide scale, the water pollution being probably a very gradual process.

For centuries, of course, men had puzzled over two kinds of immunity—one natural or innate, the other acquired after one had survived a particular disease. Cholera, for example, conferred immunity for life on him who survived. Curious preventive measures followed these observations. Asiatics made children wear shirts of sufferers from the light form of smallpox, reasoning that the children would also acquire the disease in light form and thereafter be immune from a possibly fatal attack. The Turks, on the same theory, inoculated themselves with pus from mild cases of smallpox.

Then, one day in 1880, Pasteur by accident inoculated several hens with old cholera germs—with a culture made a few weeks before instead of the usual fresh one. The hens sickened and then recovered. And they were henceforth immune.

That was the beginning of laboratory-made vaccines. Pasteur had shown, in effect, that when weakened bacteria are injected into our bodies, they work no serious harm but cause creation of anti-

How disease antitoxins are prepared. A slight injection of a disease toxin, as above, causes the development of antibodies in the blood of a horse

bodies which protect us against virulent bacteria of the same species. The immunity so conferred is called *active immunity*, because our own bodies create the protecting antibodies.

A few years later other scientists discovered that the blood of immunized animals, transferred to other animals, conferred temporary immunity to the same disease. That was the beginning of serum prevention and treatment of disease. The immunity thus conferred is called *passive*, because the antibodies contained in such blood or serum are transferred *ready-made* into our bodies.

BRAVE men have risked their lives and many have died, these last forty years, in the search for new vaccines and new serums—for always some human being had to be the first on whom the new preventive was tried. When Jack Kibbe, a private in the Army, was honorably discharged from the service recently, it was revealed that Kibbe, with a few other American soldiers in the Philippines, submitted voluntarily to inoculation with the germs of dengue fever. Doctors studied the progress of the disease among the patients, with a result that the fever rate among American troops was reduced from eighty per thousand to twenty.

When a squad of American Army enlisted men who had volunteered to risk their lives in a similar way were told that provision had been made to compensate them, they joined in refusing to go on if they were to be paid. In one of the most dramatic military scenes away from a battlefield the high officer to whom they gave their ultimatum rose and bowed and lifted his hand.

"Gentlemen," he said, "I salute you."

You will be glad to know they survived.

Recently a Philadelphia doctor announced a serum treatment for rheumatism, which is not due to old age, but is as much an infection as measles. The importance of the announcement lies in the fact that heart disease causes more deaths than any other malady; and rheumatism, according to Dr. Henry Albert, commissioner of health of Iowa, causes from fifteen to twenty-five percent of heart disease.

MORE lately two Denver physicians, Roy P. Forbes and Berryman Green, demonstrated that a child with measles can, by giving a few drops of his immune blood, protect his younger brothers and sisters from the disease. When the patient's fever begins to decline the blood is taken. Serum made from it produces a very mild form of modified measles in the children who have been exposed to the disease, and so confers immunity without making them ill.

Blood of the inoculated horse is later drawn painlessly, and the serum is extracted and administered to human beings, either to confer immunity against illness or as a treatment

Today man can make himself immune, by vaccines or serums, to typhoid, smallpox, rabies, diphtheria (temporarily or permanently, depending on whether antitoxin or toxin-antitoxin treatment is used), dysentery, plague, cholera, lockjaw (temporarily), scarlet fever and measles (temporarily).

INFLUENZA, infantile paralysis, pneumonia and tuberculosis are diseases against which immunization is still being sought by laboratory workers.

Yet we have only just begun to combat infections. We treat symptoms instead of treating root causes and effects. Frankly, we are ignorant to a large degree of the chemical constitution of living matter.

If the time and energy and ability that have been spent on metallurgy were spent on medicine we could manufacture antitoxin as readily as we can make cobalt steel. There lies a great field for the chemist who will turn his attention from dyes to biochemistry.

With the accumulation of new data on immunity, other questions rose. Are immunity and susceptibility hereditary? If no member of your family ever had the measles, can you assume that your children are safe?

"No, you can't inherit permanent immunity to infectious diseases," one doctor puts it, "any more than you can inherit susceptibility. Children acquire tuberculosis and other infectious diseases from parents only as a result of close contact with them. The same goes for immunity."

Dr. L. W. Famulener, well-known immunologist of New York City, told me that city people develop a markedly greater degree of immunity and resistance to diseases than their apparently healthier country cousins.

"The explanation," he said, "is that constant exposure to disease germs in cities over a period of years stimulates the gradual production of antibodies. You know that the injection of gradually increasing doses of diphtheria toxin into a horse will eventually make him immune to a dose that would ordinarily prove fatal. Much the same process of immunization is constantly happening to city dwellers. You get a few pneumonia germs, say just enough to stimulate the production of a few antibodies in your body. A few weeks later, you get a slightly increased dose and build up still more antibodies. Eventually in this way you may build up complete immunization to the disease.

"NOT being constantly exposed to infection in crowded streets and places, the tissues of country people do not have to build up the antibody protection.

"Similarly, the children of certain private schools in New Jersey showed a far greater susceptibility to diphtheria than public school children."

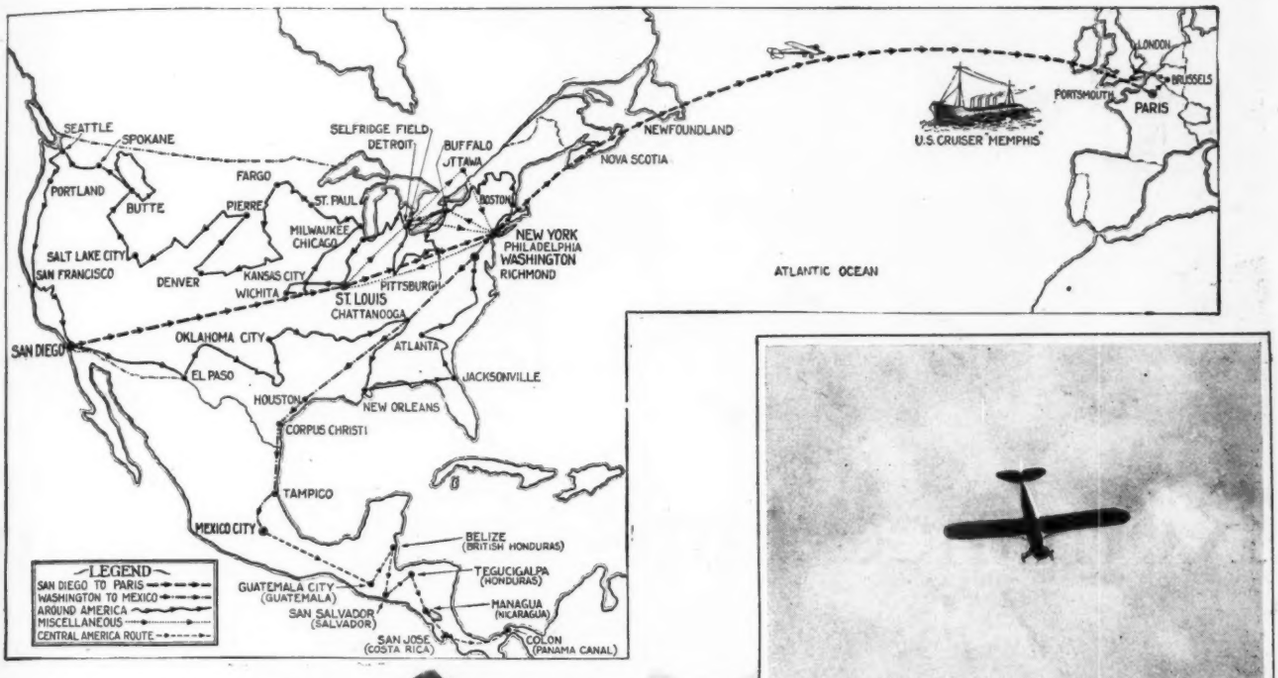
As we grow older, of course, no matter where we live, we acquire a certain degree of immunity to infectious diseases by the same process—constant exposure and the gradual creation of antibodies. But this does not apply to pneumonia and the common cold.

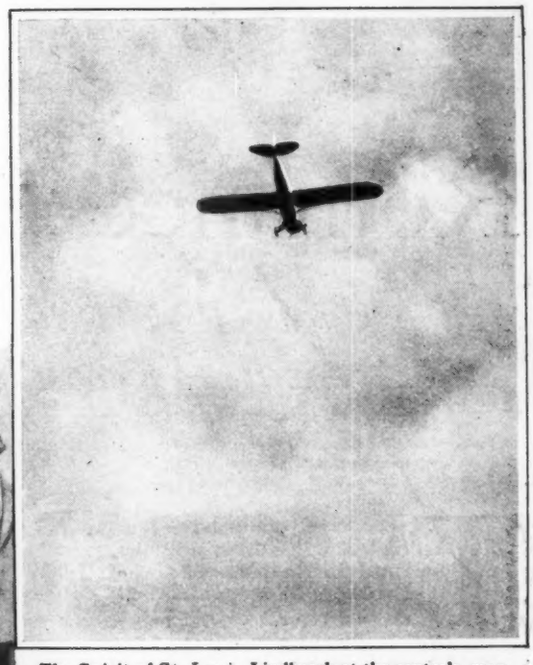
Most of us make the mistake of thinking that good health alone confers a certain immunity to infection. "Give me perfect health and I'll ride the worst epidemic," you hear. Yet the percentage of baseball players who fall victims to typhoid is above the average. Their top-notch physical condition provides no immunity against the polluted water many of them carelessly drink while traveling around the country.

Interesting experiments were made by the late Dr. Reynold A. Spaeth, of the Johns Hopkins School of Hygiene and Public Health.

Of forty white rats, twenty were regularly exercised by forced running in motor-driven drums. The other twenty were left to their own devices. After twenty-one weeks all forty were inoculated with pneumonia germs. Next day the unexercised rats were alert, bright-eyed and normal. But the (*Continued on page 161*)

"We" Smash More Records





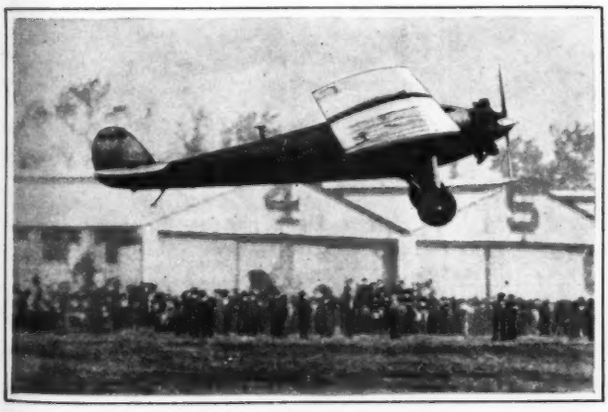
The *Spirit of St. Louis*, Lindbergh at the controls, map of their 35,580-mile travels, and Gen. Obregon (with glasses) and President Calles watching them in Mexico

Lindbergh's Plane Good as New After Flying 35,580 Miles

By
ELLSWORTH BENNETT

WHEN Col. Charles A. Lindbergh touched the soil of Central America on his latest "good will" hop, his famous mechanical partner, the *Spirit of St. Louis*, had carried him, altogether, 35,580 miles—nearly equal to one and one-half times around the globe! And this without sign of faltering, and with only a few minor repairs.

While the world renewed its tribute to Lindbergh as a genius of flight, engineers were acclaiming the triumph of his silver monoplane as one of the amazing mechanical performances of all time. Roaring at a speed far faster than an express train's, the machine had within seven months borne its pilot across the American continent, over the Atlantic Ocean, through every state in the Union, and then to Mexico City and Guatemala. And here it was, safe and sound, apparently as fit as ever!



Colonel Lindbergh and the *Spirit of St. Louis* landing at the Valbuena Airport, Mexico City on "good will" flight to Central America

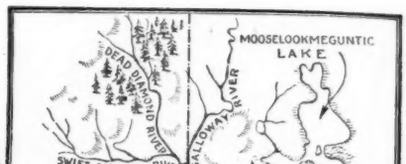
Its air-cooled Whirlwind motor had run for more than 370 hours without a failure, surviving well beyond the average life span of modern power plants of its type, reckoned at 300 hours. And it was still turning smoothly. Indeed, just before the 2000-mile trip from Washington to Mexico City, the master mechanic at Bolling Field, Washington, had gone over the plane and had pronounced it in as perfect condition as the day it left the factory!

The accompanying map shows the long trail of Lindbergh's remarkable flights since the day, last May, when he hopped off from San Diego on his great adventure. It constitutes a picture-record of unequaled mechanical and human endurance.

LINDBERGH'S return from France was quickly followed by a 22,350-mile tour of the country. This was completed without a single overhauling, and with no mechanical difficulties or forced landings. Only one failure of schedule occurred, when Lindbergh decided not to risk a landing in the fog at Portland, Me. When, at the end of the tour, the motor was taken down, mechanics found it necessary to replace only bushings, a rocker arm and two valves—after more than 32,000 miles.

Today the *Spirit of St. Louis* is still good for many more months of service.

Joe McIlroy, veteran lumberjack, teaches the author how to saw a log. Right: Map of Androscoggin drive



Romance Jams the Log Jams

Lumberjacks Risk Lives Playing with Twenty-foot Jackstraws And Dynamite to Keep Timber Moving in Lakes, Rivers and Rapids

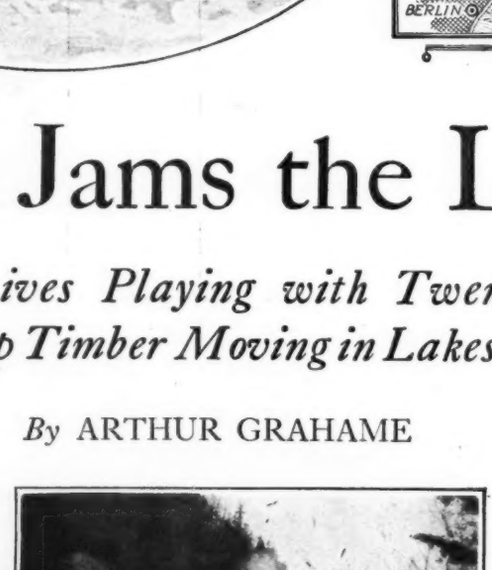
By ARTHUR GRAHAME

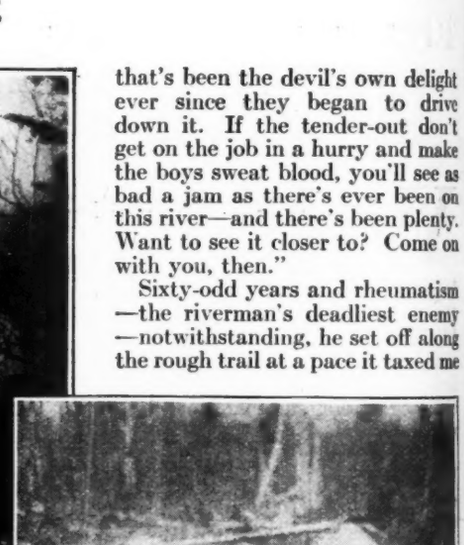
THE drive! Pulp logs—four-foot lengths of spruce destined for the pulp crushers of the voracious paper mills down river. Saw logs—twenty-foot lengths of pine for the band saws of ever-hungry mills. Thousands and thousands of feet of rushing timber, wet and slick, sometimes tossed half hidden by sheets of white spray into the thin spring sunshine, sometimes tumbled end-over-end down breath-taking rapids by the fierce swirling waters of well-named Rapid River. Above all, appropriate music—the sullen roar of the river and the harsh crashing and splintering of timber hurled viciously against boulders and rock ledges.

Old Joe McIlroy, veteran of forty-odd years of river driving, my guide when I went into the logging country to report a drive for the readers of POPULAR SCIENCE MONTHLY, gripped my arm with a weather-darkened hand and pointed two hundred yards upstream to a long saw log, its butt jammed hard into some crevice in the river's rock bottom. It had swung across the current and lodged its other end behind a boulder. Held in place by the terrific rush of water, it had become a rallying point for other logs, which, hurled against it and up-ended, were transformed swiftly into a confused, spray-drenched pile of gigantic jackstraws.

"YOU'VE been wantin' to see a log jam," old Joe shouted in my ear. "Well, there's the beginnin' of a dandy. That there ledge is the worst spot in this whole six-mile stretch of white water that's been the devil's own delight ever since they began to drive down it. If the tender-out don't get on the job in a hurry and make the boys sweat blood, you'll see as bad a jam as there's ever been on this river—and there's been plenty. Want to see it closer to? Come on with you, then."

Sixty-odd years and rheumatism—the riverman's deadliest enemy—notwithstanding, he set off along the rough trail at a pace it taxed me





In these modern days dynamite breaks up log jams that formerly took hours of labor to end, sometimes costing lives of lumberjacks. At right: Preparing a charge of "canned thunder" to end a jam on the Androscoggin. Above: The blast hurls logs in the air and their journey down the river to the mills at Berlin is resumed

to follow. The trail swung away from the river—but not out of earshot of its roar—into the warm stillness of the woods; then, after a hundred yards, back to the river. In the few minutes that we had lost sight of it, the jam had increased tenfold. It was an uneven, bulging wall of grinding, groaning logs extending across the narrow river. Water shot its way through the many crevices in this wall, but behind it more water, and thousands of logs, were piling up.

High on the bank above the jam, we broke into a small clearing in which stood a rough shack; a man emerged from the brush across the open space from us. He was a lean, slabsided man, whose long, solemn face the winds and suns of many seasons had tanned to the rich, even brown of a long-used saddle. He gave us a brief glance, then turned his clear gray eyes to the jam. After a moment he spoke, with a Yankee drawl and in the gentle voice of the Maine woodsman.

"YOU can't trust this old devil of a river a minute," he observed without malice. "I just went upstream a piece to help the boys out with a little hang-up—and now look at this." He strode to a telephone on the side of the shack and spoke calmly into the transmitter.

"He's the tender-out," old Joe informed me. "It's his job to watch the river here and see that the logs are runnin' free. Old-timer on the river—all the tenders-out are. It's a right important job."

The tender-out took up his pickpole—a twelve-foot ash shaft with a steel tip fashioned auger-wise, so a man could thrust it into a log, give it a twist, and then pull the timber as he scrambled down the bank. Now the wall of logs was damming back most of the river's flow, and the water's roar was changed to a sullen murmur that mingled with the cracking and groaning of the logs beneath the terrific pressure. So little water flowed below the jam that the tender-out was able to leap from boulder to boulder into midstream. Then, facing the treacherous, trembling timber rising far above his head, soaked by the icy water that spurted spitefully from between the logs, he began to prod and pull with his pickpole at the tangled mass, searching for the jam's key log.

"I saw my brother killed that way," said old Joe. "That was twenty years ago, up north of here on the Swift Diamond. He found the key log all right, and loosened it—but he couldn't get clear in time. Little the logs and the rocks left of him. We picked his body out of a shallow ten miles down. . . Mighty close that I came to going the same way down there on the Androscoggin, right below Errol Dam. I was on top of a jam, shovin' logs over, when out she went with me. All hell broke loose. I saw nothin' but white water and grindin' logs—and then there I was standin' on a big saw log with my peavy in my hands and ridin' pretty in a quiet pool.

"BACK in those days there was none better than me at ridin' the logs. Why, I mind once I rode one through an open sluice-gate, just to show off to my best girl. There's few that knows the trick now. Drives ain't what they used to be, and lumberjacks ain't either. There's not many left in these here woods that can use an ax even. A feller with a cross-cut saw can fell three trees to a good axman's one. I mind when—"

A flume built where natural waterways do not serve to carry logs to the nearest river or lake that will carry them on their way to the mill

A log jam on the River Joli in Quebec, where the most skillful lumberjacks in the world are claimed. At left: One of the jacks rolling a log with feet

I had been listening to old Joe with my eyes on the tender-out, playing his desperate game of jackstraws down there below the face of the jam, pushing and pulling until the sweat ran down his brown cheeks and the pickpole bent in his hands. Now, as he came leaping toward shore, there was a great to-do of shouting and singing in the brush, and a dozen lumberjacks strode into the clearing. Most of them were French-Canadians—husky young fellows, with dark faces and straight black hair and big-chested bodies—who wore gaudy mackinaw shirts, and carried pickpoles or peavies.

The tender-out came up the bank as they prepared to descend. "It's no good," he said to their foreman. "I'll have to blow her." From a box standing opened and handy at the door of his shack he took three yellow sticks of dynamite and a length of fuse, then went calmly back to the jam. Working unhurriedly and with method, he placed the "canned thunder" where it would do the most good, bent over the fuse a moment, and came unexcitedly back to shore.

We took to shelter. It seemed a long time before anything happened. Then dull thunder shook the earth, and giant logs, rent and splintered, were hurled high into the air. Before they could splash down again the eager current had seized on the logs behind them and hurried them on downstream. In a few minutes, old Joe admitted unwillingly, the tender-out, with a few sticks of dynamite, had broken a jam that in "the good old days" would have resisted an entire driving crew for hours, and perhaps hung up the drive for days.

"THEY'RE using dynamite more every year," he grumbled. "It busts up a few logs, but it saves time, and time is worth more than logs these days, with lumberjacks paid higher than they used to."

Many times on the drives I listened to that plaint of the old-timers, "Lumberjacks ain't what they used to be." Perhaps they aren't, but they still do a man's job in driving the logs down white water from where they are cut in the woods to the mills. Those that I watched at work and talked with in their wangans—"wangan" is

(*Continued on page 143*)

By
FRANK
PARKER
STOCK-
BRIDGE

Lower Manhattan bathed in a billion and a quarter candlepower of light from a Sperry searchlight in Brooklyn—illumination of efficiency greater than the sun's. Left: The machine that casts the light

Sperry—Competitor of the Sun

Dramatic Story of Modern Worker of Miracles Which Vastly Increase Safety of Land, Sea and Air Travel

A SPARE, blue-eyed man with a close-cropped, white mustache stood on the roof of a tall building on the Brooklyn side of the East River and looked across a mile and a half of space at the skyline of Manhattan. Except for a few illuminated windows here and there, behind which workers lingered at their tasks, the battlements of downtown New York were black against the midnight blue beyond the Jersey hills.

Two men wheeled a stubby cylinder mounted on a rubber-tired truck across the roof.

"All set, Mr. Sperry," called one.

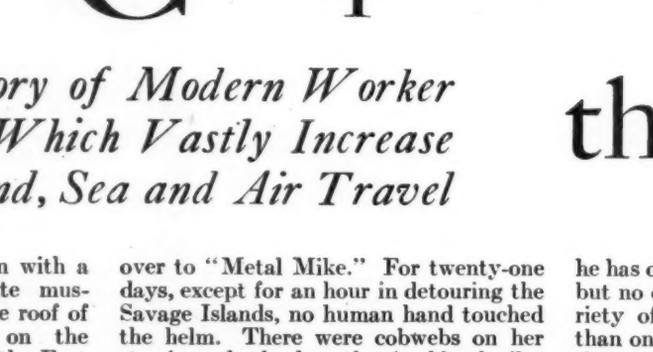
The white-mustached man pulled a switch lever and across to the towers of Manhattan shot a blinding beam.

THE Sperry searchlight, culmination of forty years and more of one man's life work, giving a light that is actually brighter, unit for unit of radiating surface, than the sunlight which reaches the earth, would be enough in itself to stamp Elmer Ambrose Sperry as one of the world's great inventors.

On August 30, 1927, the steam tanker *Pulpit Point* cleared from San Francisco for Auckland, New Zealand. Captain Owens set his great circle course true South 38 degrees West by his gyroscopic compass and turned the wheel over to "Metal Mike." For twenty-one days, except for an hour in detouring the Savage Islands, no human hand touched the helm. There were cobwebs on her steering wheel when the Auckland pilot clambered aboard.

The Sperry gyrocompass and gyrosteering device, applications to useful work of what was merely a physicist's toy, would alone mark their inventor as one of the world's most original thinkers.

BUT the acclaim of the scientific world for Elmer Ambrose Sperry is not based upon those achievements alone. Some call him the greatest living inventor; others, second only to Edison. There are men with more patents to their credit—he has only four hundred or a few more—but no other man has covered such a variety of fields, and certainly not more than one or two others have made inventions so fundamental and revolutionary. Most inventions are adaptations or improvements. Sperry's are basic.



One of the early Sperry street cars, first that could climb steep grades, built about 1894. Sperry, in derby hat, holds lever on track behind the car

ONCE in a while the public hears of Elmer Sperry, as a vague figure behind some demonstration of a new light or a new application of the gyroscope (soft "g," please), or when his professional associates honor him with the Collier medal for aviation, or the John Fritz Medal, the highest honor that can be paid an American engineer by his fellows, which was awarded to him for 1927. But the public never sees him. It is not of record that he ever presided at a public dinner or made a public speech.

But he will head the commission of seventy engineers representing the United States at the International World Congress of Engineers at Tokio in 1929.

In Chicago there is a fourteen-acre plant devoted to the manufacture of electric coal-mining machinery invented by Sperry.

In Niagara Falls are two great electrochemical industries making caustic soda and chlorine salt, based upon Sperry inventions.

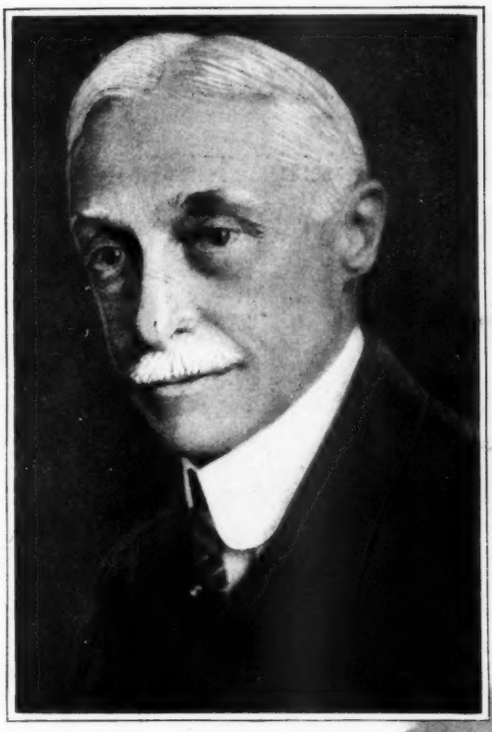
In Baltimore a factory utilizes the

scrap from all of the tin can factories of America, recovering the tin and selling it to the silk weavers and melting down the remaining iron scrap into such things as sash-weights—entirely based on Sperry patents.

The General Electric Company bought the Sperry patents on electric street cars capable of climbing steep grades.

In Brooklyn the Sperry Gyroscope Company, which makes the gyrocompass, the gyrosteerer and the gyrostabilizer for ships, and builds the Sperry searchlights, occupies a twelve-story building at the end of the Manhattan Bridge.

Every navy and great merchant fleet in the world uses these Sperry inventions for navigation. Every navy and most of the armies use Sperry searchlights. The Sperry aerial torpedo and a dozen other war machines, some of them among our Government's most carefully guarded secrets, stand to his credit.



Elmer Ambrose Sperry, one of the greatest living inventors and one of the least known to the public, because his engineering genius and creative power are equaled by his modesty

WHEN Prof. A. A. Michelson, the great physicist whose investigations of light are of extreme importance in scientific research, needed a light equal to sunlight for his experiments, Elmer Sperry alone could furnish it. And when Professor Michelson's work called for flywheels with the incredible speed of 46,000 revolutions a minute, Sperry alone could design and build them.

The night flyers of the air mail find their airports by the aid of Sperry searchlights, their beams visible as far as 140 miles from their source, shooting a billion and a quarter candlepower into the sky.

Practically all motion pictures today are made in windowless studios, for the Sperry carbide arc light makes possible better lighting effects, even for supposedly outdoor scenes, than the sun itself.

Why, I wondered, with such achievements to his credit, doesn't the public know more about Elmer Sperry the man? I went to see.

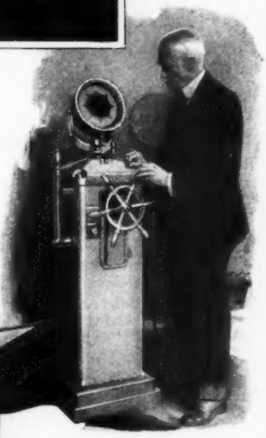
I found him at his desk in Brooklyn. His tanned face and springy step belied his sixty-seven years.

"GOLF," he said, as we spoke of a mutual friend, now long passed into the beyond, "golf would have kept him alive. He didn't know how to play. He spent all of his time working—the worst thing any man can do."

Sperry is a member of three country clubs on Long Island, where his own magnificent summer home is also situated, at Bellport. And he plays better golf than many men of his years. Yet this same man works longer hours than any other man but Edison.

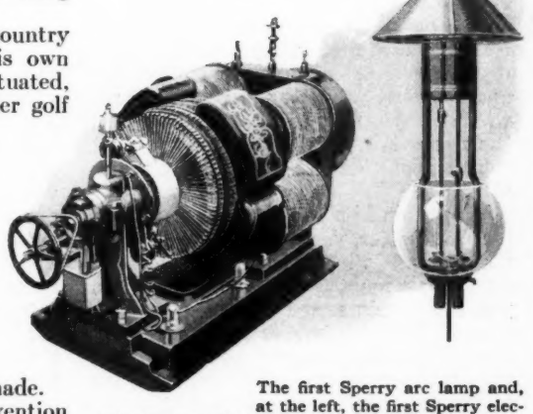
The thing on which the great inventor is working now is an electric fissure detector, to discover and mark faults in railroad rails by electrical measurements made while a car containing the instrument passes over the line. On a length of railroad track set up in his factory tests are being made.

What may prove his greatest invention is a radically new type of aviation engine, which weighs no more per horsepower than the best now in use, which requires a third less fuel to produce the same power, and that fuel costing only a tenth as much as gasoline and non-inflammable. It doesn't take much imagination to appreciate what such an engine will do for aviation, especially as it has no complex electrical equipment to get out of order.



Sperry and "Metal Mike," automatic helmsman that steers a ship by the gyrocompass. It resists every wave that turns the ship from its course

Below: An electric automobile built by Sperry before gasoline became the standard for "horseless carriage" propulsion. For this he devised a capacious storage battery still utilized today for other purposes



The first Sperry arc lamp and, at the left, the first Sperry electric dynamo which provided the current. From a tower in Chicago, a battery of these arc lamps cast 48,000 candlepower, a marvel of the nineties

THAT is the supercharged Diesel type airplane engine which Sperry has developed after nearly thirty years of experiment. He has built a number of supercharged engines of other types, many of them being successfully used in racing cars and airplanes, but he never was satisfied with the four-cycle gasoline engine; it seemed too complicated. "The Diesel engine is simplicity itself, once the weight factor can be cut down," he told me. "Everybody realizes now that the failure of so many long-distance flights was due to the weight of the gasoline which had to be carried. Crude oil or distillate, which is the Diesel engine's fuel, weighs a third less, and my problem has been to find a way to make it give more power per gallon with no increase in the weight of the engine over the best of the gasoline type."

There were many complications in the problem, but the present engine, the eighth in the experimental series, is said to have solved them all.

"WHAT is your latest application of the gyro?" I asked.

"The automatic track recorder," he replied. "That was finished about a year ago. It is used by railroads to determine the condition of the roadbed. The gyroscope, as you know, can tell if the object with which it is in contact is moving, and in what direction; and if tilted, just how many degrees. This track-recorder mechanism is mounted on a railroad car and run at any speed. It makes a record on paper, telling just the degree of banking on every curve, whether the rails have spread at any point, whether the ties are firmly bedded or are center-bound, so that one end sinks under the weight of the train. The engineers can take the picture the gyroscope draws and send their repair gangs to the precise points where things are wrong."

The recorder has been in use on the Santa Fe railroad for about a year, and is now being adopted by other roads.

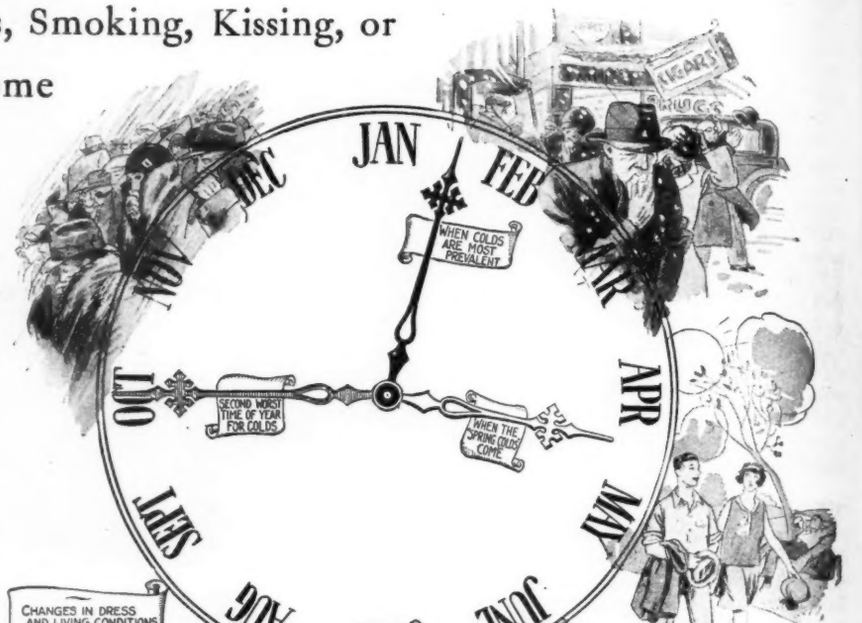
"I wish you'd explain the working of the gyroscope to me," I persisted. "What can it do? And how did you come to think of putting it to work?"

He picked up a brass model from his desk. Just a little flywheel, heavy at the rim, light at the hub. Each end of the long axle was held in a bearing in a ring of brass, just big (*Continued on page 162*)

Where *Did You* Catch Cold?

Maybe from Heavy Meals, Smoking, Kissing, or From Your Neighbor—Some New Discoveries about Our National Malady

By P. A. CARMICHAEL



THOMAS A. EDISON has said that the American people eat too much. The great inventor speaks with authority; he knows the importance of right eating. To the fact that he has long kept to a light diet he attributes much of his ability to work more hours a day than most men.

If it is true, as many doctors maintain, that we literally eat ourselves to death, it is not surprising that we sometimes eat ourselves sick. But how often does it occur to the man, woman, or child suffering with a cold that he or she has caught it from eating?

Yet what we eat has been found to be the primary cause of many of the colds with which we as a nation suffer. Take, for example, the banquets, parties, and Sunday dinners when we are tempted to overindulge our appetites for rich food. We may soon suffer from sluggishness or indigestion, but we also are inviting that insidious ailment for which we usually blame the weather or somebody's sneezing—the common cold.

Dr. Volney S. Cheney, medical director of a Chicago packing plant, suspecting that colds among the employees were due largely to overeating, kept a record of them and found strong evidence that his suspicions were correct. On days after banquets and on Mondays and days following holidays, the prevalence of colds was greatest.

The explanation, Dr. Cheney said, was fundamentally the eating of too much meat and other protein-containing food. This unbalanced the system, generated acid poisoning, and combined with lack of exercise and perhaps with other ailments already present in the body, paved the way for colds. The remedy, he said, is a diet containing plenty of vegetables.

We not only eat ourselves into colds, but some of us smoke ourselves into them. Many a man, intent on some task, excitedly lights one cigarette after another and presently finds himself hoarse.

"WHAT have I done to catch this infernal cold?" he asks. He runs over the events of yesterday and the day before, but can think of nothing he did then to induce a cold. The consequence is, he ascribes it to some mystery in Nature.

Let us suppose he had gone to a doctor. The latter would have examined his throat and, finding it inflamed, probably asked whether he smoked. When the patient had recalled his excessive smoking of the day before, the explanation would have been clear. It would have been this: The smoke irritated the delicate mucous membrane of his throat, allowing the germs constantly inhabiting the mouth and throat to penetrate the flesh and set up the inflammation.

Sometimes a surprisingly small amount of precaution will prevent such a cold. For instance, Dr. Russell L. Cecil, professor of clinical medicine at the Cornell University Medical College, reports cases in which even a change in the brand of cigarettes has been effective.

COLDS of this kind show how it is possible to contract the ailment without exposure to other sufferers or to bad weather. The reason is that we are constantly beset by an army of microbes camped in our mouths and throats. These invisible invaders are always ready to attack. Of course, they do not succeed at every opportunity, for there is an opposing army of corpuscular defenders in the blood which, when the system is in good order, usually repulses them.

Not only excessive smoking, but such things as dust and gases, extremely cold, dry air, over-use of the voice by speakers and singers, and digestive disorders, which send up substances that roughen the membrane, may cause colds.

This is one kind of cold. There is another.

When you kiss your maiden aunt—or, for that matter, your best girl—when you shake hands with a friend you haven't seen for six months; and, of course, when you fall within range of the fellow who charges the atmosphere with germs by coughing and sneezing—when, in other words, you come in contact with carriers of the germ, you are in danger of catching this second variety of the disease. Strange to say, this kind is contagious; whereas the other kind, which we catch without contact and without exposure, is not.

To demonstrate the contagiousness of the second variety, Dr. Peter K. Olitsky, of the Rockefeller Institute for Medical Research, conducted a series of interesting experiments. He took washings, or cultures, from the throats of cold sufferers and with these swabbed the throats of several well persons. The result was, with few exceptions, that he produced typical colds. In the cases where the colds failed to "take," the persons from whom the cultures were obtained had been infected eighteen to twenty hours, whereas, in the other cases, the infections were only a few hours old. All of which indicated that colds are communicable in the early stages but not in the later.

So far as medical science knows, the agent which causes colds may be so minute as to be invisible under the most powerful microscope. Dr. Olitsky put all the washings he used through the finest filter, thus straining out all the known bacteria, and yet transmitted the disease. He concluded, therefore, that the cause is apparently a filterable virus.

GENERATIONS of warnings against exposure have left in most of us an almost instinctive dread of cold or damp weather, in which, we think, there lurks our death of cold. Lately this idea has been widely challenged. Colds, we have been told, are not caused by exposure, but by germs. The question has been investigated experimentally, just as was that of the transmission of colds, with the result that we now have the findings of science for a guide.

In St. Louis, at the Washington University Medical School, a group of volunteers submitted (*Continued on page 136*)

A New Brood of Lindberghs

How Uncle Sam's Sky Classrooms Are Teaching Awkward Fledglings to Become Great Flyers

By MAJ. GEN. JAMES E. FECHET
Chief of Air Corps, U. S. Army

FIFTEEN hundred feet above Brooks Field, San Antonio, Texas, a biplane skidded uncertainly in wide-sweeping circles. In the cockpit a goggled young flying cadet, right hand clutching the "stick," feet moving gingerly on the rudder controls, struggled in the grip of a strange predicament.

Here he was, up on his first solo flight—and for the life of him he could not get down to earth again! Worse still, the fuel tank was running dangerously low!

For fully half an hour he had been chasing round and round that endless circle, hawklike. Directly below he could see a curving row of little bird houses—the hangars and barracks of the flying school. Beyond, to the southwest, miles of farm land stretched away toward the Gulf of Mexico.

HOW to get down? He tried to repeat to himself the directions often given by his instructor. He tried to bring back the "feel" of the ship on previous occasions when with dual controls the veteran pilot had demonstrated to him how simple it was to land. But try as he would now, he could not bring himself to make the dive to earth.

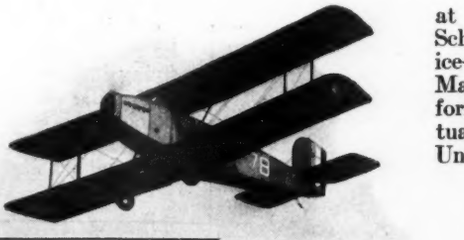
On the ground a group of officers signaled frantically.

"If that boy is sitting around up there waiting to fall down," grumbled one, "he won't have to wait long."

Almost as he spoke, the engine of the plane missed, sputtered and died. The officers watched anxiously. A stall—a sickening tail spin—anything might happen now. Instead, to their surprise, they saw the nose of the machine sink slowly and deliberately. With a graceful glide, the powerless plane winged downward until it swept to a perfect landing!

The cadet stepped from his ship, grinning sheepishly. The officers, vastly relieved, could only shake their heads and laugh at this "ground shy" fledgling who could rise to the do-or-die emergency with instinctive resourcefulness and find his wings. True, he had brought the emergency upon himself, but in meeting it he had laid claim to that coveted possession of every great pilot—the flying instinct.

With a fresh supply of fuel the cadet took off again, and again landed, this time under power. Time and again he repeated the performance until his original shyness of the earth had been conquered. Today, having completed his schooling, he is a crack pilot of a large eastern air line.



One of the many thrilling experiences of the advanced air students, sometimes for practice and sometimes to save their lives when they get into difficulties — a parachute jump. The flyer is seen below the airplane, which speeds on; the parachute is just beginning to unfold

Major General James E. Fechet, Chief of the Air Corps of the U. S. Army

ON the first of this March more than two hundred ambitious young men, like this cadet, set out to try their wings at the two Primary Flying Schools of the Army Air Service—at Brooks Field and at March Field, Riverside, California. They are from virtually every state in the Union. Most of them never have ridden an airplane, nor have they a clear idea of how it is built or how it works. But all are fired by the desire to fly and by the ambition to find a successful career in the air.

SOME are destined to succeed spectacularly; some will prove to be naturally unfit and will turn to other pursuits for which they are better adapted. From this raw bunch of groundlings, however, will emerge men who will be among the great pilots of tomorrow—men trained in the same thrilling school of experience that helped to produce a Lindbergh, a Chamberlin, and many another successful flyer of today.

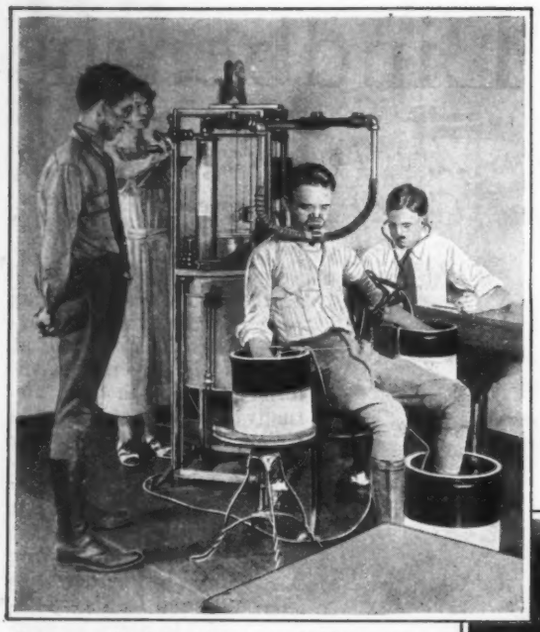
They will find many opportunities—as officers in Army flying units, in mail or the varied commercial air lines, in designing and building airplanes. The whole fascinating realm of aviation, you see, opens before these prospective pilots.

Under the Government's five-year program of expansion in aviation, the Air Service stands in need of skilled officers. That is a chief reason these youths are being given the great chance. At present our air forces are undermanned. We have less than a thousand pilots, less than 9000 enlisted men, and 205 flying cadets. Under the new program we shall require at least 1650 commissioned officers, 1800 serviceable airplanes, and 15,000 enlisted men, including 500 flying cadets.

Training planes lined up at Brooks Field, Tex., Primary Flying School, ready to start the day's flights shortly after 6 o'clock A.M.

BUT to enter a Primary Flying School one must measure up to definite qualifications. He must be between twenty and twenty-seven years old with two years' college training or its equivalent, sound as a dollar physically, with perfect hearing and sight; and well recommended as to character.

Arrived at the flying field the



Testing student's reactions to rarefied atmosphere such as he will have to breathe in high flight

beginners are brimful of enthusiasm and confidence, but before many days they begin to wonder if this flying thing is as simple as it looked.

To be sure, almost anyone can learn to fly an airplane, but to be a successful military pilot a man must fly instinctively, as if his ship were a very part of himself. Such a pilot is Lindbergh. It is this so-called "inherent flying ability" that enables a military pilot to make half a dozen quick decisions in an emergency, or to perform such tasks as map making and photography with hardly a thought of the mechanical operations of flight itself.

Consequently, the earliest experiences of the flying cadet are those for determining whether he possesses this elusive quality—whether he is a born flyer.

MOST surprising is a machine known as an orientator, which reveals the man's ability to "find himself" when whirled and tumbled about by the evolutions of a plane. In a cockpit suspended within three concentric rings, the "pilot" is looped, rolled and spun through every conceivable experience and must bring himself back to an even keel after each upset.

There are other ingenious testing devices—for example, a whirling chair that determines a man's sense of equilibrium, instruments that test his judgment of distance, machines that measure how readily his muscles respond to a sharp command or a flashing signal. In addition, searching questions disclose his family and personal history, his habits, peculiarities and temperament—all this to reveal any nervous weaknesses which later might cause him to break under trying circumstances.

Some time ago one of the most brilliant cadets crashed two days after his graduation. Later it was discovered he had been subject to occasional fainting spells which somehow had escaped the qualification inquiry.

The first two weeks—all "ground work"—pass somewhat tediously for the boy who is impatient for the air. In the first week he must learn military fundamentals; during the second he gains his first knowledge of the theory and mechanics of flight.

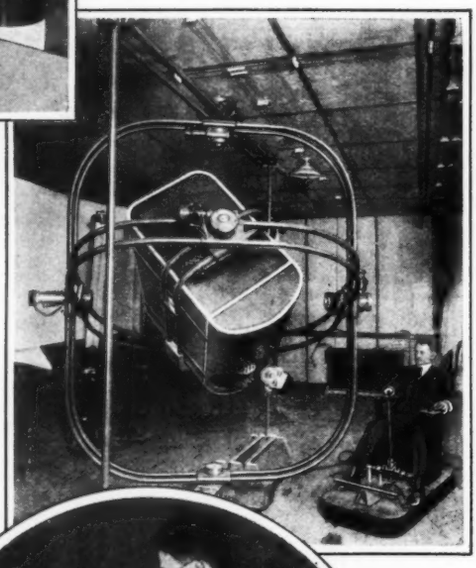
THEN the third week brings the great day when he goes up for his first actual flying instruction.

Proudly he appraises the machine he is to ride. It is a PT-1 special training biplane, designed for stability and low landing speed, and driven by a 150-horsepower motor. Its fuselage is all metal, with strength to withstand a severe crash. The instructor climbs into the front seat, and the student takes his place in the rear. That first flight is little more than a sight-seeing tour, with the instructor presiding; but the pupil acquires something of the feel of the ship. Next morning the cadet has his first lesson in handling the controls. These are in duplicate, one set for the instructor, the other for the pupil. On the edge of the upper wing are mounted the instruments in view of both men—air speed indicator, altimeter, tachometer and oil gage. As they fly the men converse through speaking tubes connected with the earpieces of their helmets.

"Hold the stick—lightly now . . . Now your feet on the rudder bar." The future pilot obeys the commands, studying the movements of the mechanism and the response of the ship.

FOR days this sort of training continues. Then at last, at a height of about two thousand feet, the instructor holds up his hands to show that he has relinquished control, and the youngster has his longed-for opportunity. Nine times out of ten, the plane begins to skid and slide crazily about the sky and the instructor comes to the rescue. But soon the pupil finds the nice balance between rudder and ailerons that keep the machine straight and level. Every day brings some new achievement—first gentle turns, then steep turns, spirals, and landings; then aerial acrobatics, especially the tail spin. Almost invariably, when a pilot stalls his plane, it goes into one of these vertical spins. The controls go limp, and have no effect. Eventually the student learns the trick of getting out of a tail spin by kicking over the rudder to form a pocket which catches the air, lifts the tail of the ship and brings the nose down.

After about twenty half-hour flights with his instructor the pupil, if he has shown steady progress, is ready for "solo work." If he has failed to progress, he faces the "benzine board." Other instructors go up (*Continued on page 158*)

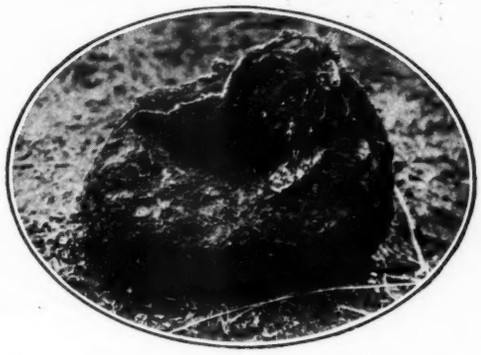


Upper photograph: Flying heels over head, the cadet tries to right himself in the orientator, a cockpit operated to duplicate the evolutions of a plane by the instructor seated near by. Middle: Testing vision. A cadet at either flying school must see perfectly without glasses. Lower: Flying cadets learning how to repair wings, fuselage and propellers in the woodworking shop of the school

Bits of Old Clay Kick up a Big Row

Bitter Dispute Divides French Archeologists—Are Carvings Dug Up 10,000 or Only 10 Years Old?

By GEORGE LEE DOWD, JR.



A Glozel find. A clay block that may have held a Stone Age idol. Did caveman or a joker make it?

Part of the "Museum of Glozel," showing some of the relics of which it is the crude temporary repository. The most interesting feature of this group is constituted by the strange bowls which represent human faces with eyes but without mouths

THREE thousand so-called prehistoric relics, dug from clay two feet under the soil of a peasant's farm in the hamlet of Glozel, France, today have divided French archeologists into two bitterly hostile camps in a controversy to determine whether a fascinating new chapter shall be added to the early history of mankind.

One group of experts pronounces the relics the most important of European archeological discoveries. In seemingly ancient stone implements, weapons, vessels, carved bones and inscribed tablets they find evidence of a remarkable Stone Age civilization which they believe existed in Western Europe perhaps as long ago as 10,000 years—more remote than ancient Egypt.

Opposing these Glozel believers are equally respected experts who contend that the entire "find" is a gigantic hoax perpetrated by some industrious jokesmith.

THE conflict came to a head a few weeks ago in the report of a special International Commission of Anthropologists, eight in number, appointed to decide if the relics were genuine. The report called the "discovery" little more than a daring and ingenious fake.

But this finding only fanned the conflict to greater heat. Immediately the Glozel believers charged the commission with bias and fraud and, led by Saloman Reinach, Director of the Museum of Saint Germain-en-Laye, took their grievances to the French courts. There the matter boils at the present writing.

It all began in 1924, when the plow of a French peasant, Emile Fradin, turned up a number of curious and apparently ancient implements and inscribed clay tablets. Dr. Morlet, a physician and antiquarian living near by in Vichy, became interested. Searching farther, he and others unearthed thousands of vases, axes, flint arrowheads, bone harpoons, stones with ground edges, fragments of glass vessels, and also evidences of an ancient tomb.

Chief interest centered on the carved tablets, seeming to indicate that prehistoric cave men used an alphabet centuries before the ancient Phoenicians, generally credited with the invention of the ABC's. The inscriptions included more than a hundred signs and characters. Curiously, half of these bore striking resemblance to Phoenician, old Greek, Etruscan, Latin, and other ancient writings. Certain symbols were similar to those found in such far separated parts of the world as Peru, New Zealand, Scandinavia and Mexico. Others were entirely unrecognizable.

AMONG other surprising discoveries were more than a dozen clay figures representing the human face, with round eyes, but without trace of a mouth! Carvings of reindeer heads appeared on small stones and pieces of bone.

Reinach attributed the relics to primitive people who probably were common to what are now France, Spain and Portugal. Later they vanished, possibly migrating to the east under pressure of invaders from the north. This, he says, might explain the similarities between the Glozel inscriptions and the writings of early Mediterranean peoples.

"The collection," says the commission, "is simply the invention of someone who had wit enough to place some genuinely old axeheads and other fragments with others of bone and pottery which he had carefully and patiently fashioned himself."

The commission contended that the carvings bore every evidence of having been cut with modern metal chisels; that an "ancient" oven unearthed was not over seventy-five years old; that many of the "prehistoric" bones actually were new.

The scientific jury gets first-hand information by visiting the scene of the find – or the "crime" of fakery, as they adjudged it—on the farm at Glozel, France

The Real Story Behind *the New* Ford Car

By EDWIN KETCHUM

The new car and its 64-year-old maker, who just smiles when some engineers say he cannot make profit even if he sells 10,000 a day

DOWN a Michigan road, not long ago, rattled a dilapidated "tin lizzie." Over the steering wheel crouched a tall, gaunt, gray-haired man; a small boy at his side.

Henry Ford was the man. The car was a new Ford, secretly built and disguised under a body of ancient vintage. The small boy had been picked up along the roadside because Henry Ford wanted from his lips an unbiased opinion of his new car—an opinion he could get in no other way.

Ford's new cars, already dotting the highways, are the climax of the most spectacular drama in the history of the automobile. One man, by sheer driving personality, dominated it. Success, wealth, fame were his, yet he would not sit idle and let others build his new car. Ruthlessly he scrapped men and machines and started over again. At sixty-four he undertook the hardest task of his life, harder even than the production of his first car more than a quarter of a century ago. He was everywhere at once, passed on every idea, tested most of them personally. Never before has there been such a story of an emergency autocratic control of a mammoth industry—of inventive persistence, and inventions made to order on a huge scale.

Ford seized the first new model as it came from the assembly line at the great Fordson, Illinois factory. "Is this the best you can do?" he asked his engineers. "Yes," they told him. "I'll represent the public, then," he said; and a second later the car, with Ford at the wheel, leaped out upon a near-by field. When he returned, after bumping over stones and logs, he declared, "Pretty good, but it bounces. Put on hydraulic shock absorbers."

AND so, day after day, the new Ford was changed and modified and improved. Ideas for integral parts came from chance remarks of his aides, sometimes on country drives far from the designer's room. Frequently Ford would enter his factory, already engaged on production, and say, "This part is not right. Let's try it this way!" A part would be built and tried. If it didn't work, the idea was scrapped and a new one developed. Trial and error on a titanic scale!

I went out to the great Ford experimental laboratory near Detroit a few days after the new car was announced to the public to find out the unpublished details of the gigantic new start of the Ford Company. Yet at that great plant few people really knew anything about the things I wanted to know. But Sorensen knew—Charles E. Sorensen, Ford's right-hand man, in charge of production. And it was to him I went first.

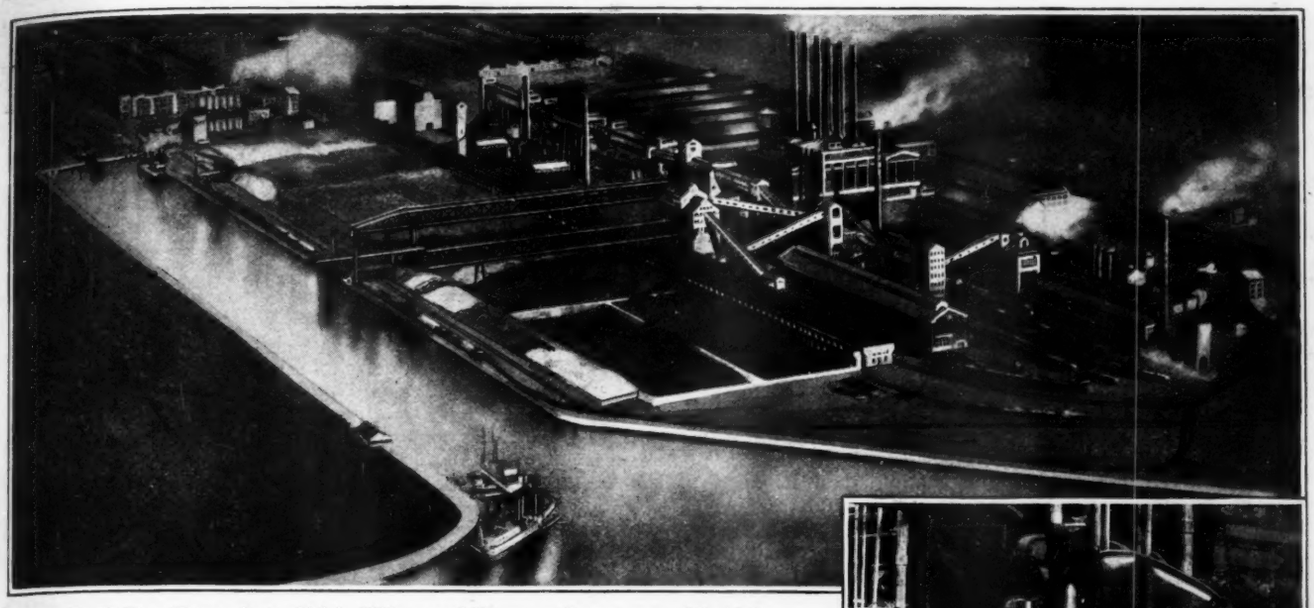
Better steel at lower cost would be needed for a better car. That was decided several years ago when the new car was first discussed. Mr. Sorensen and a few others, a very few others, knew, therefore, just why Ford purchased obsolete vessels from the Shipping Board and acquired a glass factory and new timber lands. Henry Ford was going to produce a new car from his own raw materials in his own factories.

THAT was the program Ford outlined for himself in 1922. To carry it out he had to scrap the costly machinery of the largest and most successful automobile factory in the world. For weeks great machines had to stand idle. Thousands of men had to be thrown out of work temporarily. Ask any business man what it means in dollars and cents to stop such a plant for even a day, and you will have some idea of the courage it took Ford to determine to build a new car whose success no one could foretell.

First there was talk of making the momentous shift after the ten millionth "lizzie" had been made; but "there never seemed to be an opportunity to get the new car started," Ford said, so the fifteen millionth Ford was set as a tentative turning point.

Meanwhile Ford laid down his fundamental orders. "Build a car designed for a need, not any definite price," he told his engineers. Specifically, he demanded a machine that could go sixty miles an hour.

A mile a minute! That called for a forty-horsepower motor. Shall it be a four-cylinder car or a six? Ford demanded a low speed motor. Such an engine, spinning its crankshaft 2600 times a minute, can develop forty horsepower with four cylinders. A four it was to be, then. "Better make the cylinder chambers about as wide as the distance the pistons



Henry Ford's River Rouge plant, which in 1924 covered 65 acres and now, as one of the birthplaces of the new Ford cars, occupies more than 115 acres. This does not include the area devoted to breaking up 199 old ships to utilize their material in making the new Fords

travel up and down," Ford directed, explaining that he favored the "square" engine, with bore and stroke nearly equal.

So Ford, master engineer, had his ideas built into the motor that was to drive his creation—an entirely new motor from the ground up. Strength! That must be the keynote of the crankshaft—the sturdy, looped, whirling shaft through which power from the aluminum pistons flows to spin the car's wheels.

Was it balanced? In action as well as at rest? Ford wanted to know, for if it was even a trifle unevenly weighted, it would vibrate and shake the whole car. A precision testing machine proved its balance.

THE engine was satisfactory. "All right," Ford said. "Build a compact car around it. A light car, but one that will hold the road." Some of those engineers may have told their wives that the task was impossible, but they didn't tell Henry Ford.

It is the "unsprung weight" of a car, the weight of the wheels, axles and everything not hung on springs, that jolts and bounces when it strikes holes in the road. Ford found unsuspected ways to eliminate unsprung weight—a rear axle housing of spun steel, steel-spoke wheels, changes in the front axle and the new four-wheel mechanical brake system, all lighter without loss of strength. Even the springs themselves, usually attached to the axle by their heavy end, were reversed so that their own weight would be "sprung"!

Now an up-to-date gear shift was required—a break with years of Ford precedent. The frame itself, forged throughout, for strength. Colors, too, for the body—Edsel Ford chose for his father the two shades of blue, the gray, and the sand-color that became the new finishes. Accessories? "The best," Ford said. Even the old familiar "squawker" horn was scrapped.

THERE was the car—on paper, but there were no machines in existence that could make, in quantity, some of the things that Ford had put in it—a gasoline tank electrically welded of steel covered with anti-rust lead alloy, for example. "We'll invent our own machines," Ford decided.

Ordinary electric welding machines couldn't make the gasoline tanks because the current sputtered and failed momentarily as it flowed through the bearings to the welding disks. One of Ford's men hit upon the scheme of running the bearings in mercury, a good conductor of electricity, and that problem was solved.

To spin hot metal into rear axle housings, a device like a huge potter's wheel was invented. Instead of clay, it whirls a red-hot forging; a special forming tool pressed against the metal flattens it into the dish-shaped housing. Now that machine makes three a minute.

Thus new machines were invented. Existing ones were modified. Ford found that he must scrap and replace a quarter of all his machines, valued at forty-five million dollars! Half could be made over, the remaining quarter could be used as they stood.

The secret of the Ford success has been mass production, developed to a degree that left men of lesser imagination gasping. Now he would make them gasp again. He would not only make the cars, but make the materials that went into them. Besides his own steel plant, he built a factory to manufacture unbreakable, three-ply glass for his windshields. Fuel for his plants came from his coal properties in Kentucky and West Virginia. His Michigan timber lands supplied him with wood. Obsolete vessels went into his furnaces and emerged as metal for his cars.

Then Ford faced the greatest decision of his life. Should he stop the plant in the midst of production and go ahead with the new model? Or play the safe course; stick to the old familiar car and the parts business? Millions were at stake.

Welding gasoline tanks with machine invented for the purpose. Mercury keeps the current constant

"We'll make the new car now," he said, and one spring day of 1927 he drove the fifteen millionth old-type car off the Highland Park assembly line. Then the plant shut down.

Out came the old machines at Highland Park and Fordson. New machines sprang up—among them forging presses that shaped frames of cars at one mighty blow.

Then came the Fordson plant's gala day. Down the assembly line rolled a shining new car with Sorensen at the wheel. Behind it came a second, a third. Here was the new Ford!

And yet Henry Ford wasn't satisfied. He disguised a few of these first cars and started picking up small boys around Dearborn to get their verdict. He got it and gave the machine to the public.

How much did it cost? No one knows. A staff of accountants could easily find out, of course. The point is that they don't. Ford apparently doesn't care how much it cost and obviously he isn't worried about those engineers who say he can't make money on the new car.

"When we began work on the new model, we had $350,000,000 in the bank. Now we have $250,000,000," he said.

That is the story of how one man built a car that set the world talking.

What We Owe to Newton

The Story of a Farm Boy Who Built Queer Toys, Made the Universe Hang Together, and Became One of the Supreme Discoverers of All Time

By ARTHUR A. STUART

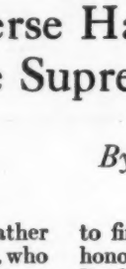
AN ENGLISH farmer's son, rather dull in his early school days, who carved his name on a stone window sill when he should have been conning his lessons and spent his leisure at home in making doll furniture for girls and queer toys for himself, received the homage of the civilized world during the last year on the two hundredth anniversary of his death.

He was acclaimed as one of the supreme discoverers of all time, a scientist with few equals through human history.

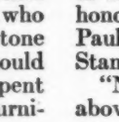
If Darwin and Aristotle are excepted, who else can stand beside him who found the laws underlying the movements of all celestial bodies and put into mathematical form the poet's music of the spheres?

Sir Isaac Newton made the universe hang together by the bonds of gravitation. He guaranteed the scheduled arrival and departure of every heavenly body, whether speeding hundreds or thousands of miles an hour. He proved the reign of physical law on earth and extended it to the utmost abyss of space. He replaced chance with certainty, fear with rational assurance and superstition with knowledge. He increased the dignity and stature of man. Someone has said that all of us today are standing on Newton's shoulders.

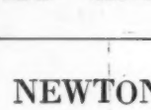
NEWTON'S SIX GREATEST WORKS



By discovering gravitation as a universal law, he brought order out of chaos, knowledge out of superstition.



His improved methods of calculation placed knowledge and achievement on a basis of mathematical precision.



He guaranteed the movements and positions of heavenly bodies, and so made safe, exact navigation possible.

His spectrum analysis of white light paved the way for a host of useful optical discoveries and inventions.

He originated a mathematical basis for all modern physics. For isolated facts he substituted the rule of law.

He invented the reflector telescope. By study of the stars he gave to the world a wider view of the universe.

WE HEAR that Einstein, who discovered relativity, has made Newton a back number, out of date and obsolete. Nevertheless the universe still proceeds according to the daily time table devised by the English mathematician. Einstein himself concedes that the laws of his predecessor continue to have a practical validity. Planets yet swing in their orderly paths and are spaced with relation to their fellow planets and their suns by the rules of mass, motion and gravity as laid down by Newton. Doubtless Einstein has found new truths. They do not cancel but extend the old ones.

Despite the popular idea, Newton was not the first to discover gravitation nor to find its exact law. Why then do we honor him? The answer is given by Dr. Paul R. Heyl of the U. S. Bureau of Standards:

"Newton stood head and shoulders above his contemporaries because he had vision, a broad mental grasp. Scientific knowledge before his day consisted chiefly of isolated facts. . . But Newton was able to visualize all the moving bodies in the universe from comets to falling apples, and to demonstrate that they all obeyed a single law—universal gravitation. He brought order out of chaos; he had constructive talent; he was a builder."

No book as epoch-making as Newton's "Principia" appeared until Darwin's "Origin of Species" was published in the middle of the last century. The first book dealt with physics, or matter, and the second with biology, or life.

Today the "Principia" is taken for granted; the picture of the universe set forth in it is part of our common heritage, almost innate.

Some reader may wish me to clarify further the seeming contradiction between Newton's greatness and his stated lack of originality. Let us put it thus: Others guessed; he proved. Others collected bits of knowledge mingled with error; he selected the elements of truth and assembled them into a mighty edifice.

AT THE age of twelve Isaac Newton stood near the bottom of his class in public school. One day another boy "gave him a kick on the stomach, which occasioned a great deal of pain." This was the most salutary and useful kick in history. It woke up Isaac completely and was the turning point in his career. He saw more red than he ever discovered later in the spectrum, pummeled his assailant to a standstill and, as a neat finish, took him by the ears and rubbed his face against the churchyard wall. Isaac's chest expanded. Then he realized that the boy he had whipped stood above him in school. This would not do. He resolved to win a mental as well as physical victory over his foe. He began to study and earned first place in school.

At home Isaac had a kit of tools and amused himself building models. One of these was a windmill like a big one in the neighborhood. To make the windmill perform inside the house, the boy inventor rigged up a treadwheel on which he installed a mouse, which was lured to travel forward by a bait of grain hung just beyond its reach. Isaac also made a water clock. This was framed in an old box and stood four feet high.

THE dripping of water on paddles or the like was the motive force and caused the dial hands to register. The boy kept the device in his bedroom and gave it a day's allowance of water every morning. It was such a practical clock that everyone in the house kept time by it.

As an improvement on the water clock, Isaac turned to sundials. The first ones

were based on rough observation of where shadows fell on house walls and roof at different times of the day. Wooden pegs were placed "to mark by their shadows the hours and half hours." With increasing knowledge and skill, the youngster produced more accurate sundials. He carved two of them on the masonry walls of his home, and it was said the neighbors came around to ascertain the correct time by what was known as "Isaac's Dial."

THE reader and I may smile over this ancient crudeness; we have clocks and watches galore and the daily check-up of radio time from Washington. Yet on second thought we get our time from Isaac Newton as did his neighbors. That radio time signal is merely the transit moment of a star whose apparent movement follows Newtonian law.

Young Isaac made a horseless carriage which was propelled by the power of the occupant. Lacking smooth roads and ball bearings, this ancestor of modern vehicles had no chance. There was better luck with the manufacture of paper kites. Somehow the boy knew how to figure the proper shapes of kites and where best to attach the strings. By hooking a paper lantern containing a lighted candle to the tail of a kite which he launched at night, Isaac scared the country people into thinking they saw another comet, which was supposed to portend disaster.

There was the gentle pastime of making doll furniture, as tables and cupboards, for girl friends. No doubt this furniture was done to scale. One of the girls, a Miss Storey, might have become Mrs. Newton if the young man had been financially able to marry. While in the period of catering to the dolls or girls, whichever it was, Isaac wrote verses and drew diagrams and pictures which he colored and framed to decorate his room.

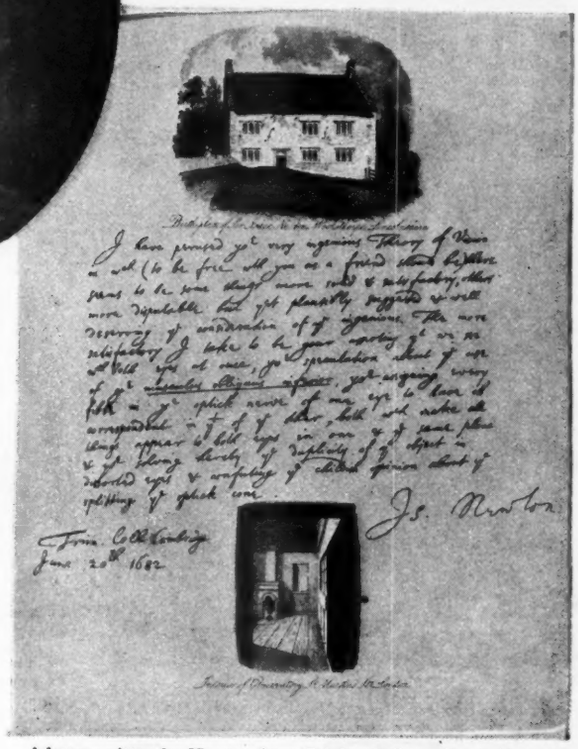
Sir Isaac Newton, from an old portrait. "I seem to have been only like a boy playing on the seashore, while the great ocean of truth lay all undiscovered before me"

The verses were probably a total loss. Color in pictures pointed to optical discovery. Diagrams were the essence of his life work.

Isaac's father had died before he was born. Relatives thought the boy had the makings of a farmer, but when he showed no interest in agriculture, brightened up in school, and was found one day doing a mathematical problem under a hedge, they decided to further his education. Around nineteen he entered Cambridge University. At a village fair he bought a book on astrology, and in order to understand this dubious but popular sister of astronomy he saw that he needed more mathematics. So he invested in a copy of Euclid. And like many youngsters before and since, he felt that the father of geometry dealt in self-evident kindergarten truths and tossed Euclid away "as a trifling book." Newton then proceeded to bog himself in the advanced geometry of Descartes. At length he realized that kindergarten truths were the necessary foundations of knowledge, went back to Euclid and from that time made more orderly progress.

As with other geniuses, the germs of great discovery came to Newton when he was young, a college student in the early twenties. He then invented the mathematical method of fluxions or calculus, analyzed white light into the rays of the spectrum and had his first glimpse of the law of gravitation. It was probably in the autumn of 1665, when Newton was twenty-three, "that the apple is said to have fallen from the tree at Woolsthorpe, and suggested to Newton the idea of gravity." Voltaire had the apple story from the favorite niece of the great Englishman, and we might as well believe it.

"When sitting alone in the garden and speculating on the power of gravity," writes Sir David Brewster, Newton's



A letter written by Newton from Trinity College, Cambridge, at the age of forty, describing his studies of the theory of vision

biographer, "it occurred to him (Newton) that as the same power by which the apple fell to the ground was not sensibly diminished at the greatest distance from the center of the earth to which we can reach . . . it might extend to the moon and retain her in her orbit, in the same manner as it bends into a curve a stone or a cannon ball, when projected in a straight line from the surface of the earth.

"IF THE moon was thus kept in her orbit by gravitation to the earth . . . it was equally probable, he thought, that the planets were kept in their orbits by gravitating towards the sun. Kepler had discovered the great law of the planetary motions, that the squares of their periodic times were as the cubes of their distances from the sun, and hence Newton drew the important conclusion that the force of gravity or attraction by which the planets were retained in their orbits, varied as the square of their distances from the sun.

"Knowing the force of gravity at the earth's surface, he was, therefore, led to compare it with the force exhibited in the actual motion of the moon in a circular orbit; but having assumed the distance of the moon at a certain figure, he found that the force by which the moon was drawn from its rectilineal path in a second of time was only 13.9 feet, whereas at the surface of the earth it was 16.1 in a second." (*Continued on page 133*)

The discovery of the spectrum. Newton let sunlight pass through a hole in the window shutter and then through a glass prism, thus separating the white light into its color elements

The professor, tears streaming down his cheeks, knelt beside the girl. And there, under the moon, the strange story tumbled out in broken English, while Judy bathed Margaret's face

The Movie Maker

A Close-Up of Mechanical Magic Behind the Screen Revealed in This Romance of Courage and Ingenuity

By S. W. NEWMEYER

Illustrated by Ernest Fuhr

DON KENNEDY, red-headed young director of the comedy section of Popular Players' West Coast Studio, and Judy Burke, his script girl, shared the high ambition of some day producing a big feature picture. Toward this goal Judy had written an excellent scenario, while Don had invented a new photographic process by which action photographed in a studio might be superimposed on backgrounds taken anywhere in the world, thus effecting enormous economies in production. Jacob Eckstein, president of Popular Players, had promised Don his chance; but just when the young director's hopes seemed about to be realized, they were dashed by news that Popular Players was forced to suspend operations because of financial difficulties. The trouble was due to enormous expenses incurred by the famous but temperamental director, Carleton, in filming a gigantic historical spectacle in the Orient. Eckstein, however, offered to turn the "lot" over to Don for six months, rent free—provided he would assume also the high-salary contract of Margaret Moreland, a beautiful but fading screen star. Though Don had only a few dollars to his name, he accepted. It was a wild gamble against big odds. Judy offered her scenario and her services without pay; then induced her brother Jerry, a stunt flyer, to join them. That night the three young partners attended the first performance of Margaret Moreland's latest picture, "Frozen Hearts." With them was Professor Mahrlenburg, an eccentric old photographer whom Don had befriended, and whose admiration for Margaret Moreland amounted almost to a passion. The picture was a failure—a pitiful anticlimax to the screen star's brilliant career. The show ended, they saw the star, in disgrace, hurry from the theater and speed away in her sport roadster. Suspicious of her manner, they followed in Jerry's car—out into the country at breakneck speed. At last, near the crest of a hill, Margaret pulled to the side of the road and stopped. Still following, they found her standing on the edge of a declivity. She raised her right arm. Steel gleamed in the moonlight. Jerry leaped from the edge of the road and flung himself upon her. A shot, a spurt of flame, and the two struggling figures plunged forward. Now read on:

THE girl, fighting so desperately for death, became a limp weight in Jerry's arms as the fence ripped loose and they toppled forward. With the instinct of an airman, Jerry threw himself and his burden into a side-slip, and they shot along the dirt at the edge of the precipice. As they rocked on the edge, Jerry struggling to turn the balance to safety, strong arms pulled them to the road.

Jerry sat up as Don knelt beside them, but Margaret lay motionless on the road.

"Dead?" gasped Don.

Before the white background rode Jerry and Margaret, in medieval garb. Don took his place at the camera man's elbow. "Ready—action!" he called through the megaphone to the two

"Not so you'd notice it!" Jerry rubbed his aching side. "Only fainted. I knocked the gun out of her hand just as she fired. Better tie her up before she comes to. She's got the manners of a wildcat."

In spite of his remarks, however, he was gently shifting Margaret to a more comfortable position, with Don's aid, when both men were pushed aside and the professor, tears streaming down his cheeks, knelt beside the unconscious girl.

And there, under the cold moon, the strange story tumbled out in broken English, while Judy bathed Margaret's face with water from the radiator of her car.

THE thousand-dollar-a-week star was the daughter of the penniless old professor! A runaway at sixteen from an English boarding school, Margaretha Mahrlenburg, self-christened Margaret Moreland, had refused to be forgiven and taken home like a naughty child when her father had found her in Hollywood two years later. As Don listened, he realized that only a near-tragedy could have brought those two together, so alike were they in their fierce pride.

Jerry, who had disappeared down the road to get his car, now pulled it up beside them, and as Don helped the old man and his daughter into it, he felt sure the events of the night had dissolved their bitter stubbornness and reconciled them completely.

Certainly something had melted the almost haughty reserve for which Margaret Moreland was famous, for as Judy tucked the abandoned ermine cape around her, she leaned against her father, her body occasionally shaken by sobs she could not control. Judy settled herself on Margaret's other side and Jerry drove carefully away, leaving Don to follow in the big racer.

Where the road widened, however, Don passed them, and when Jerry's car trundled into the drive of Margaret's home in Beverly Hills, he was waiting there for them, his arms loaded with small bundles.

"Tried to rouse someone," he told Margaret, "but they're sleeping like the dea—like logs," he finished hastily.

"There's no one in the house." Margaret stepped from the car, quiet and composed as usual, but with a new gentleness in her manner. "My servants are out."

"Well, I don't know how you folks feel," remarked Don heartily, "but I'm starved, so I went on to the delicatessen and got the makings of a Dutch lunch. How about some hot coffee and a bite to eat?"

"Righto!" Jerry took the key from Margaret's hand and sprang to the porch. He flung open the door with a flourish. "Opening the Moreland Cafeteria, ladies and gents. Line forms to your right."

Margaret stepped past him, snapping on the lights from room to room as she went through the house to the kitchen. They trooped after her, Jerry and Don keeping up a stream of lively comments and would-be jokes, none of them very funny but all lending cheer to the coldly silent house.

Judy's eyes were too busy for her tongue to function. She stared round-eyed at the beauty of Margaret's home—not large, but as exquisitely fitted and furnished as a jewel box. Silk damask wall coverings, old rose in the living room, golden-brown in the library, dull blue in the dining room. The inlaid grand piano in the pale blue and gold music room, where Judy paused for a prolonged peek, must have cost twenty-five thousand dollars, she estimated.

But the kitchen was a gay little place shining with Delft blue and white tiles, a porcelain clock like a Dutch plate ticking away on the wall. Margaret enveloped them all in voluminous white aprons and set them to work. Soon the appetizing fragrance of hot coffee mingled with the savory incense rising from a Welsh rarebit, and they all crowded around a small table in the breakfast alcove. As Margaret ladled out the thick yellow mixture, she looked up at the professor with a smile.

"FATHER, do you remember the marionette theater you made me one Christmas?"

"One of my happy memories, it is," he replied. "But I now have made you something finer—something that will astonish the critics when they see your next picture!"

Margaret shook her head slowly.

"The critics—and my *dear* friends—will wait a long time before they see my next picture," she remarked in a low tone, "perhaps forever."

Fumbling at length in his pocket, the old professor drew out a long slip of paper and handed it to Don. It was a certified check for twelve thousand dollars!

"But no!" exclaimed her father. "Have they not notified you at the studio that Don—"

"Mr. Kennedy must know that I have no feeling against him as a director," Margaret looked across at Don with a friendly smile, "but I'm sure he will understand that I cannot allow my face to be used as a stop for custard pies—even if I am old and passé, as Eckstein told me this morning," she finished bitterly.

"Eckstein!" roared the old man, pounding the table. "What does he—"

"Let me explain." Don's voice was quiet, but it had a note of authority that silenced Professor Mahrlenburg. "I want Miss Moreland to understand the entire situation before she decides."

Margaret listened attentively, though without enthusiasm, while Don outlined Eckstein's terms and conditions. But her attitude began to warm as, aided by Judy, he told her of the picture they had planned. When he spoke of the screens designed by the professor to make her look younger, Margaret flashed her father a grateful smile.

"And you have backers?" she asked Don as he finished.

"NO," HE replied frankly, "and I may not be able to find any. In fact, without you we have nothing at all but Judy's story and my invention. I don't even know, now, how I'm going to pay your first week's salary—so it might be more profitable for you to hold Eckstein to your present contract, even if you have to sue him."

Margaret looked down thoughtfully at the huge sapphire on her little finger.

"If I sue Eckstein," she said slowly, "he will drag the case through the courts, humiliate me—and I've had as much humiliation as I can stand. For months I've been taking powders to put me to sleep at night, but they've lost their effect. Night after night I've lain awake looking at my life, watching myself grow old, losing beauty, love, even respect. That is why . . . tonight . . . " She paused, the shadow of terror in her eyes, then raised her head gallantly and looked at Don. "Tonight I thought I had nothing left that the world wanted, but if you need me in your picture, Mr. Kennedy, I'll donate this—" she drew from her finger the large sapphire ring and handed it to him—"and the amount of my salary to the venture!"

Judy clapped her hands and Jerry waved his paper napkin with a mild hurray; but Don, usually the silent, serious member of any group, thumped the table with a large spoon and jumped to his feet.

"That calls for a speech," he declared. "Tonight I almost lost hope for the big picture, but now Miss Moreland's given it a fighting chance—and we'll fight, the five of us! We'll do things they say can't be done, and with just ourselves owning the picture, writing, directing, acting, selling it, we won't have to buck interference from higher-ups. It'll be like the old days of Biograph, twenty years ago, when Griffith himself acted, directed, cranked the camera, shifted scenes, and wrote scenarios; when Mack Sennett carried the camera and played heavies—"

"MARY PICKFORD wrote scenarios, too," chimed in Judy, "and acted leads without her name on the program, and brought her family and friends in as extras—Jack and Lottie Pickford, the Gish girls, and—"

"And began giving the public what it wanted," interrupted Don, taking the floor again. "That's what we're going to do. Now, here's my scheme for starting the big picture."

It was dawn when the three men drove away in Jerry's old car, leaving Judy to finish the night, or rather the day, with Margaret. It had been agreed that all should work without salary, the amount due each to be charged against the picture and deducted from its first profits, the remaining profits to be split equally among them. From the money Jerry had planned to spend for his new airplane, he advanced Don a thousand dollars to pay his and the professor's living expenses during the making of the picture.

Now to raise the money for production expenses! Don estimated they would run well over a hundred thousand, in spite of the great economy his universal background device would make possible, for the picture was to be a super-special of the type that often means an outlay of close to a million dollars.

Sunday afternoon the group met again at Margaret's home. This time a sixth and very important individual was added to the conference—"Bozo" Biddle, camera man of the unit that had produced "Frozen Hearts." Bozo had been Carleton's first camera man until that temperamental director had picked an entirely new company to take across the Atlantic for his big historical picture. And as everyone on the lot was aware, Bozo was still sore because he had been rejected. He not only knew his lights and lenses, but all the queer corners and beauty spots of the world were charted in his memory, for he had been a newsreel photographer many years before being employed by Popular.

Bozo was the man Don had selected to take the camera on a jaunt through Europe and part of Asia to record the location on the reels, while the cast was to stay at home and do the acting against blank backgrounds and specially prepared sets. Then Don's universal background device would combine the two into a big spectacle picture.

"All you've got to do," explained Don, "is to carry the camera, plenty of film, and a stop watch. Shoot three or four reels in England—an old Norman castle that looks pretty much as it did in the twelfth century, a few miles of English countryside without any modern landmarks, a river scene—anything that has ancient atmosphere. Give us plenty of long and medium shots and foregrounds, with a lot of detail such as moats, drawbridges, massive doorways, and old courtyards. And don't forget to take as many stills as possible, interiors especially. We'll need them for our scene painters."

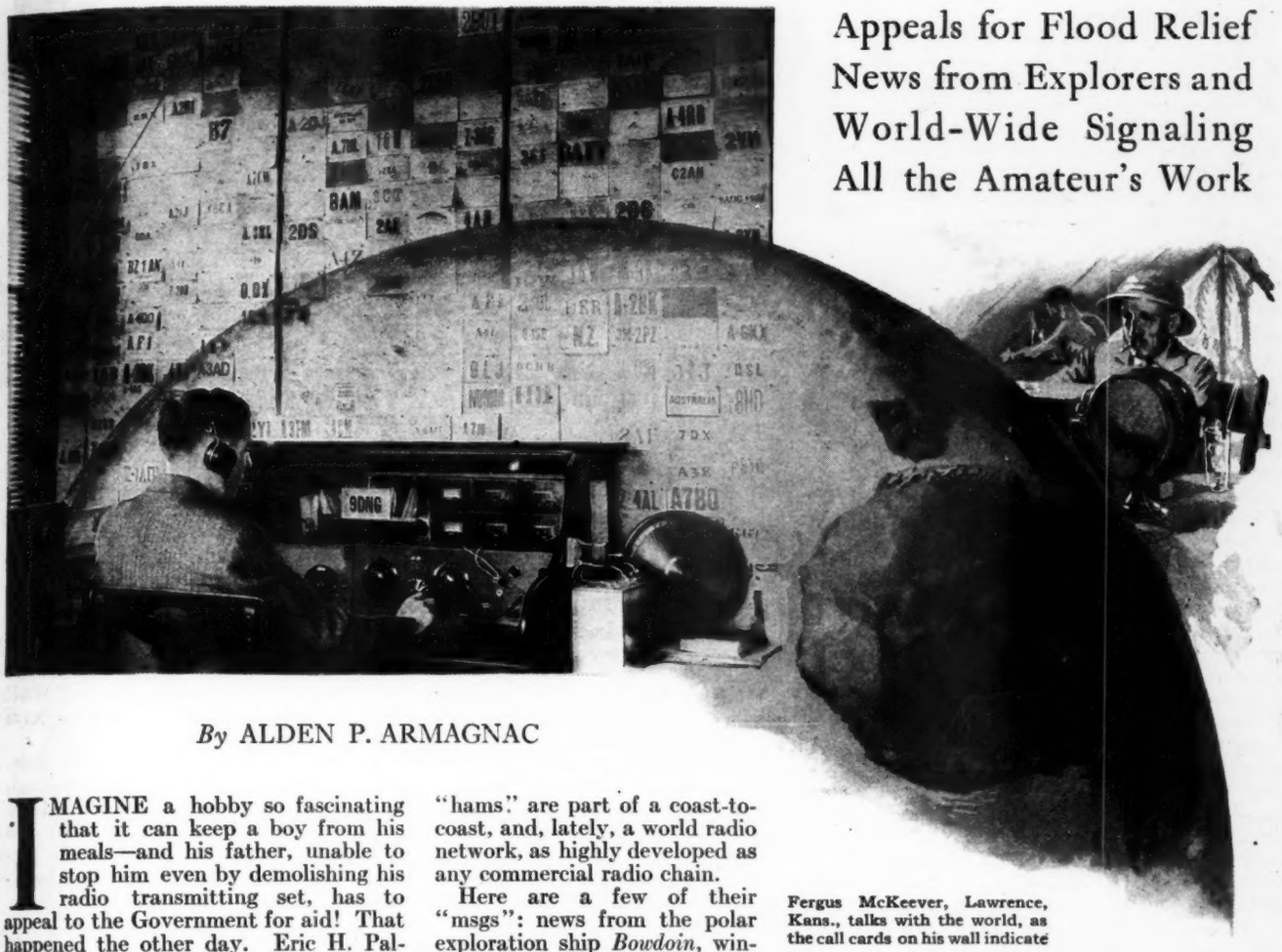
"BUT what's the stop watch for?" asked Bozo, puzzled.

"To keep a record of the exact time you crank each shot, so I can duplicate it here on the lot," Don replied. "And be sure you inclose the time record with each reel."

Bozo was delighted with the assignment. At the railway station next noon Don met him with money for the trip, a detailed script of the scenario, and a long list of (*Continued on page 167*)

Triumphs of Radio's "Hams"

Appeals for Flood Relief News from Explorers and World-Wide Signaling All the Amateur's Work



Fergus McKeever, Lawrence, Kans., talks with the world, as the call cards on his wall indicate

By ALDEN P. ARMAGNAC

IMAGINE a hobby so fascinating that it can keep a boy from his meals—and his father, unable to stop him even by demolishing his radio transmitting set, has to appeal to the Government for aid! That happened the other day. Eric H. Palmer, of Brooklyn, N. Y., sat down and penned an urgent letter to the Federal Radio Commission at Washington, D. C.

"Please revoke my son's license to operate his amateur station 2ATZ," the father wrote. "I do not believe he has seen the sunlight in three months. He transmits all night, sleeps in the daytime, and eats but one meal a day. I believe the boy will die of undernourishment and lack of sleep, and his mother will fall the victim of a nervous breakdown."

Dots and dashes flashing through the ether this very moment are the conversation of sixteen thousand boys and men throughout the country. Like young Palmer, they have made amateur radio their hobby—if more temperately than he did, no less enthusiastically.

"HAMS" they call themselves. No tame evening spent before a loud-speaker satisfies them. After supper you will find one of them in his attic "radio shack," clicking the key of his home-made transmitter mounted on a desk-shelf beside the hissing radiator. His sleeves are rolled up, and head phones are clamped on his ears; as he presses his key he converses with a friend thousands of miles away. Call cards acknowledging the talks are exchanged.

Not every one knows that the radio "hams" are part of a coast-to-coast, and, lately, a world radio network, as highly developed as any commercial radio chain.

Here are a few of their "msgs": news from the polar exploration ship *Bowdoin*, wintering at Labrador; an appeal for help from Vermont, stricken by flood; Army advices from Fort Monmouth, N. J.; an America-Europe conversation between two "hams," and incidental chats among the several thousand amateurs who were not already busy sending, receiving, and forwarding those messages.

THAT was the meaning of some of those dots and dashes you could have heard on Palmer's short wave length receiver, far below the waves of broadcasting stations. And so the Federal Radio Commission, while it suspended Eric Palmer, Jr.'s license for ninety days, told him in a letter:

"America is looking to its 16,000 amateur operators, in which group you stand out, to keep it in the foreground of development. Those of us who were pioneers will soon be forced to turn over the reins of radio to you boys, and we want you to be strong and healthy, as the burdens will undoubtedly increase as new avenues for radio are opened by you and your colleagues. This is a marvelous field for the American boy, and such enthusiasm as you have displayed should as a rule be commended rather than discouraged, but in order to develop into a big, strong, healthy boy you must have regular meals and your full quota of sleep."

What part do amateurs play in radio? Independently of all commercial stations, they link the United States and most of the world. They will gladly transmit for you, without charge, a message to anyone, anywhere. They keep newspapers informed of what is happening in isolated places, promote world fellowship by the friendly interchange of messages between continents, and by experiment constantly raise the art and science of radio above the high point where they have already largely helped to place it.

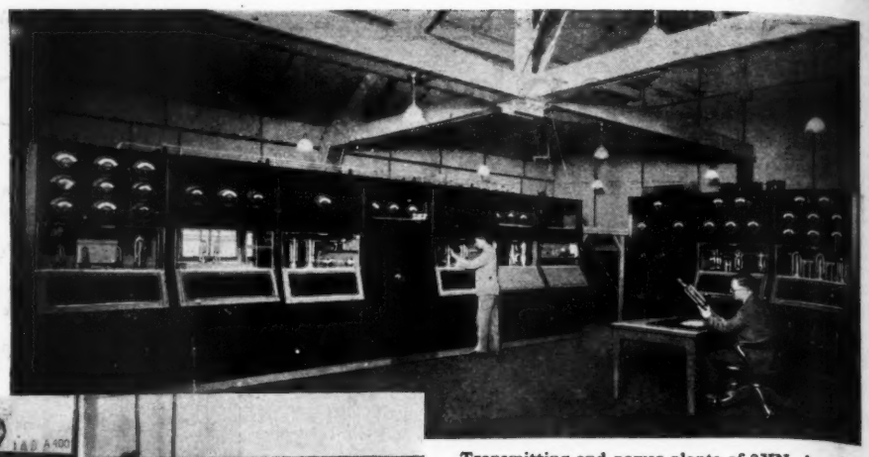
WIRES were down in Vermont, not long ago. Through the crackling static flashed a sputtering CQ—"anybody answer."

Arthur Kent, at Binghamton, N. Y., spun his dials by chance to forty meters. "CQ," came a faint call, and Kent seized his key. "8BTO standing by," he shot back. "Go ahead."

In a whir of dots and dashes, from Ralph Harris, 1BEB, came the first direct news out of Montpelier, Vt., since the flood hit it—of people marooned on the roofs of houses, Lieut.-Governor Jackson dead in Barre, bridges, roads, rails washed out. 8BTO acknowledged message after message, some for help and others to relieve anxiety of relatives,

until one o'clock in the morning, when Harris sent, "You are my only contact out of this city. Power off, electric light plant under water. Using doorbell batteries. Done all we can. Guess . . ." His messages, forwarded to Washington, set in motion the agencies that brought relief to the stricken area.

Another amateur, at station 1BDX, flashed the first direct news from Barre, Vt.; another, in Connecticut, quit sending only when the water was coming over the top of his table! When city electric power failed, some amateurs sputtered away with motor car spark coils. A Vermont amateur's signals weakened, then came back as 2CUQ, New York City amateur, copied them. "Just kicked the batteries out of water on to dry place," was the laconic explanation. The Army Signal Corps is compiling the names of amateurs who will be officially commended for the part they played in the crisis.



Transmitting and power plants of 3XN, American Tel. and Tel. Co. experimental station, Whippany, N. J., probably the most powerful in the world

This amateur station looks crude enough in comparison with that above, but with such apparatus radio "hams" have girdled the earth

IN BLIZZARDS, when railroad trains are stalled and wires down, the radio amateur gets the message through to the dispatcher's office. A special radio call, "QRR," is the railroad SOS.

When a tornado raged down on Murphysboro, Ill., an emergency call appealed to C. B. Harrison, operator of the only radio transmitter near by. Up into the forbidden wave channels of broadcasting stations the amateur tuned his wave. Every listener heard a ghostly voice break into the evening program, giving news of the calamity and urging doctors and nurses to board a relief train on its way to the stricken town. How that train, jammed with workers, brought relief to stricken Murphysboro is now history.

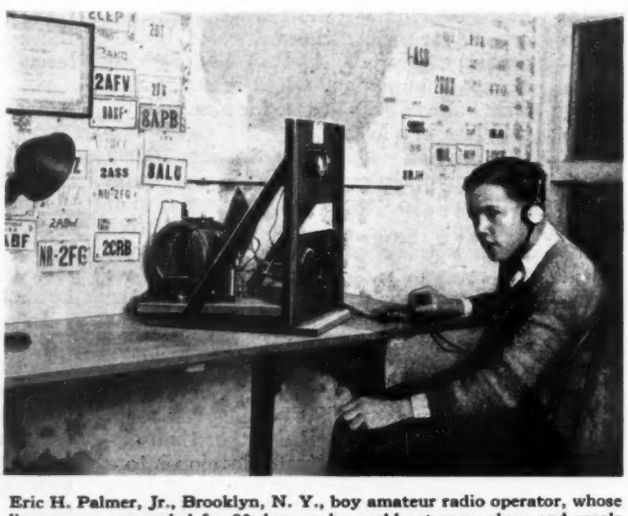
During the ill-fated Dole flights from California to Honolulu last summer, an amateur "tie-up" of local stations flashed last-minute news between Hawaii and the mainland. And through the modern miracle of the "ham's" short waves, he has rendered a service that is exclusively his—keeping the world in touch with explorers.

Donald Cadzow, ethnologist of the Putnam Baffin Island Expedition on the schooner *Bowdoin*, flashed a radiogram from polar seas to amateur station 8DNE, Auburn, N. Y., to give the first news of Arctic discoveries that change the map of North America. "Personal messages from home," the explorer said, "were flashed over the mountains and ice fields to the expedition by Charles Heiser's radio station, Auburn, in an uncanny way, when even the greatest stations of the country could not be heard." They gave the explorers the novel experience of reporting their discoveries minute by minute and receiving radioed congratulations from home. What a contrast to the old days of months-long treks with dog teams to carry news to the nearest outpost!

Thousands of personal messages are sped on their way over the "hams" carefully worked out "traffic routes" through stations all over the country.

THEIR call letters, such as 1BEB and 8DNE, are assigned by the Supervisor of Licenses. The number that precedes the radio call letters designates in which of the nine radio districts of the country the amateur station is operating.

In national emergency, such as war, the "hams" will instantly place themselves at the disposal of the Government with a reserve communication chain of inestimable importance. The Navy Department has disclosed plans to organize expert amateurs of the Eastern district for training in handling Navy messages. In a year the Army, which introduced the scheme, has handled through the amateurs 15,000 messages. It uses its Fort Monmouth, N. J., station, 2CXL, as a hub.



Eric H. Palmer, Jr., Brooklyn, N. Y., boy amateur radio operator, whose license was suspended for 90 days so he could get some sleep and meals

The world is a little too small for radio amateurs, any "ham" will tell you. William A. Mackay, distinguished New York mural painter, converses regularly with a friend in Cape Town, South Africa. G. F. Gaede, of Paterson, N. J., recently picked up a message from Liberia and, notifying the U. S. Department of State, sent back its official greetings. Many American "hams" belong to the "WAC Club," composed of those who have "worked" all continents.

Let your mind wander back to July, 1914, when the boy fortunate enough to have a "wireless set" commanded awe from his acquaintances, and no one dreamed that more than 5000 new amateurs a year would be applying for licenses by 1928.

THAT month came an important announcement. The American Radio Relay League was being organized under the auspices of the Hartford, Conn., Radio Club. This league, now the backbone of organized amateur radio, directed the entire series of epoch-making tests that led to trans-Atlantic amateur radio and greater conquests.

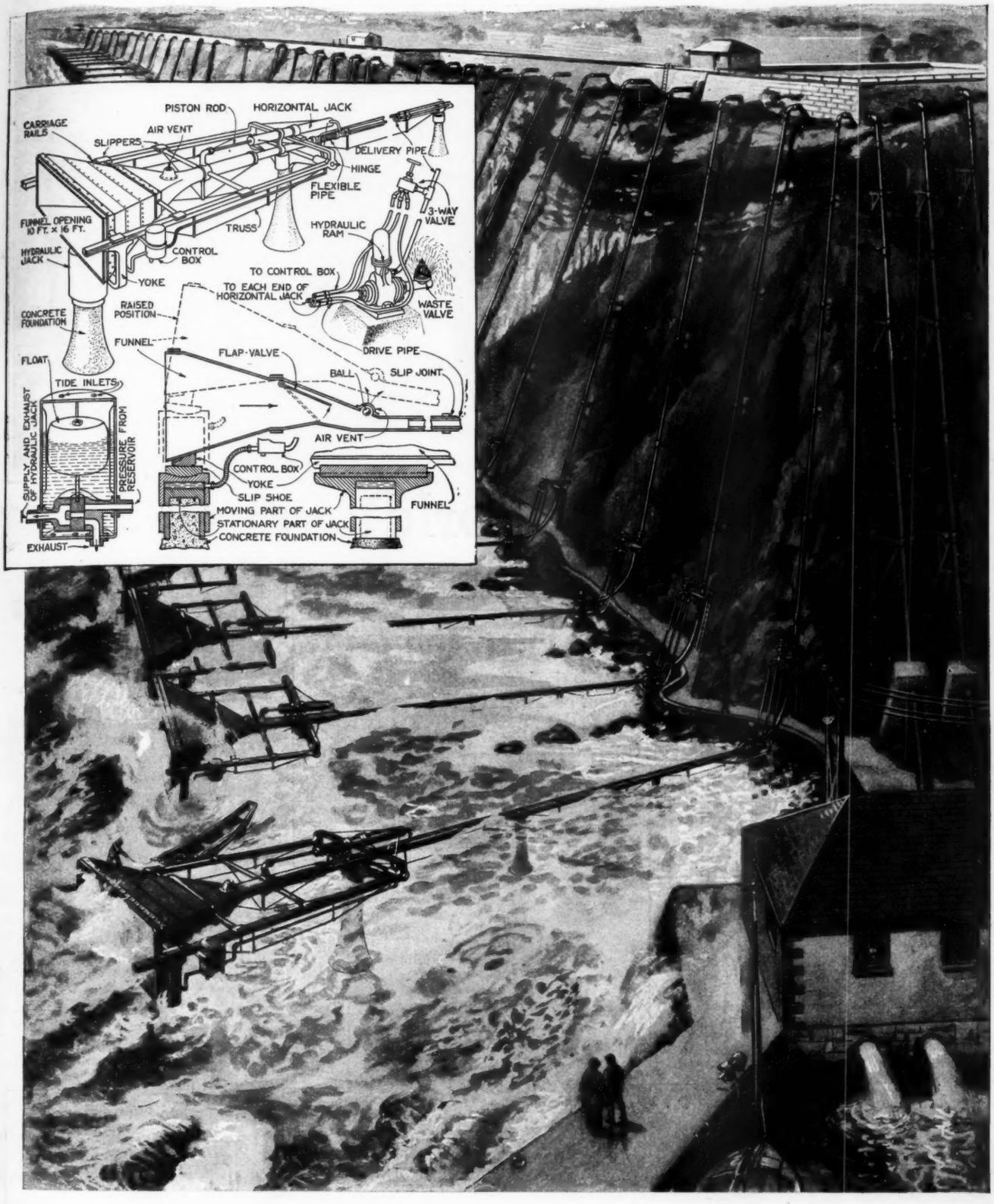
Wireless fans rushed to join the League, and before long a new language had sprung up—a curious, abbreviated code. You might be puzzled by this sample:

"Ur sigs QSA OM fb . . . hw do u lik mi spk? . . . tt's gd cuming fm u . . . sounds lik mi YL singing hi C . . . hi . . . sa cudn't u drop in sum nite es wk sum DX wit me? . . . tonite? . . . cul . . . best 73's."

When translated, this becomes:

"Your signals are coming in strong here, old man—fine business! How do like my spark? That's good coming from you—sounds like my young lady friend singing high C (laugh). Say, couldn't you drop in some night and talk to some distant stations with me?

(*Continued on page 141*)



Sea Waves to Drive Novel Power Plant

TO LET the ocean waves do the work of man by providing hydroelectric power, Lieutenant Commander Lybrand Smith, of the Navy Department's Bureau of Engineering, has designed an amazingly ingenious battery of hydraulic rams, illustrated by this schematic drawing and the accompanying diagram.

The drive of the waves into the great funnels forces the water through pipes up the cliff into the long flume along the edge of the cliff. This flume carries the water into the reservoir, from which the accumulated water pours down larger pipes with sufficient force to operate the generating machinery in the power house below.

The hydraulic rams operate hydraulic jacks which are simply valves so arranged that the water forced into them by each successive wave does not fall back when the wave's strength is spent, but is locked in to remain until more water is forced in by the next wave. Each valve, like a door that opens but one way, is pushed open by the water's force. When the force is exhausted the weight of the water closes the valve, holding it shut until the next wave presses hard enough to open it.

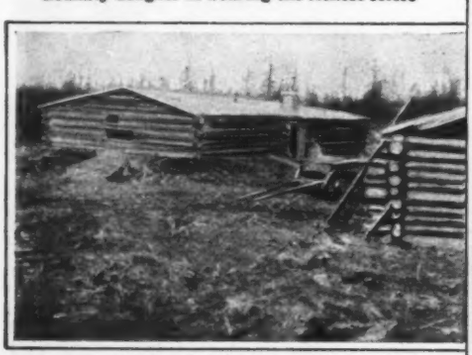
Surveyors exploring and mapping the hitherto virtually unknown interior of mysterious island which shelters one of the world's most romantic enterprises

The World's Greatest Timber Crop

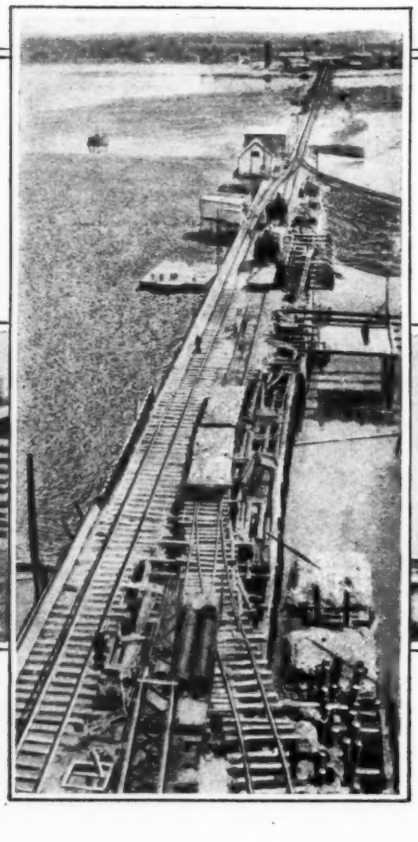
Amazing Machines Help Glean 150,000 Cords a Year on Strange Island

A typical Anticosti lumberman, who seems to have stepped from the pages of fiction. This man, like many of his fellows, is especially fond of fine but comfortable clothing and particularly delights in wearing the richest colors

The rigors of Anticosti's deepest winters are faced by the surveyors, whose work must go on regardless of weather. Snow shoes, fur and wool boots help them to resist severest cold



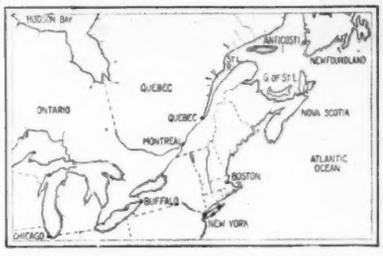
In camps of this sort the bushmen, as the lumberjacks are called, live for months without visiting even the little settlement of Port Menier. Provisions are brought to them partly by rail and partly by foot to replenish their store, which is always sufficient for many weeks. Right: Construction work on pier at Port Menier, showing part of the 50,000 cords of wood on hand in the retaining basin



A "limy," one of the queer locomotives built for Anticosti lumbering. The double-jointed, loose-hung engine runs on eight drivers, operated by bevel gears and universal joints, driven by cylinders set amidships and slanting downward. Not speedy, by any means, but the engines are incomparable when working on grades and curves and in carrying tonnage that would make ordinary engines jealous

Through winter almost innumerable miles of pulpwood are piled on the snow along railroads to be transported to Port Menier in the summer time. This is the huge industry built by Henri Menier, French chocolate manufacturer

Cape Observation, Anticosti. The picture gives one some idea of the bleak character of the queer place

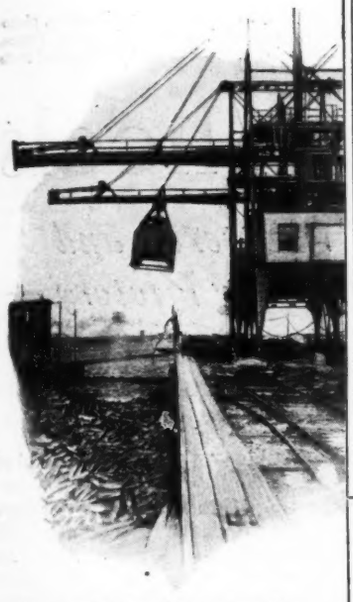


Map showing Anticosti's distant location

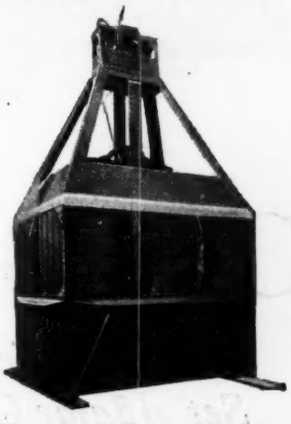
ON THE little forest-covered island of Anticosti at the mouth of the St. Lawrence River the largest lumbering operation in the world today is running full blast, supplying 150,000 cords of pulpwood a year to American industries. There is nothing like it anywhere.

Only 140 miles long by forty wide, this island contains close to 15,000,000 cords of pulpwood.

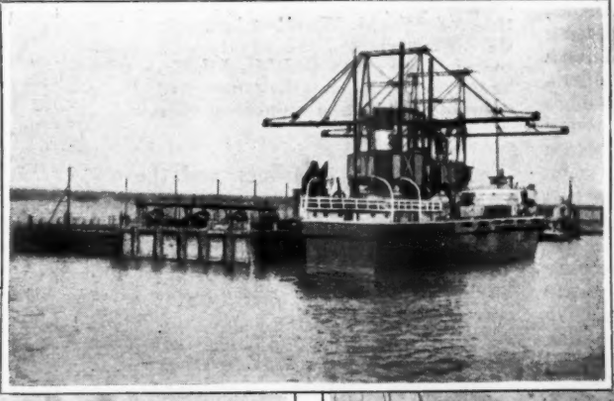
These pictures give an idea of the huge enterprise, to develop which ingenious inventions have been made. Besides seventeen miles of railroad, with locomotives and rolling stock, the equipment includes a fleet of caterpillar tractors, curious "alligator boats" for use on land or water, and powerful dredging and loading machines.

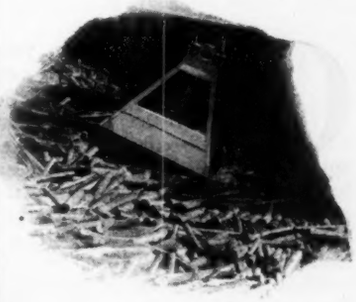


Above and at the right are two views of the pulpwood loading machinery, called loading towers, devised to load 50 cords an hour. They work night and day when they can to make up for the three winter months in which no ships reach Anticosti

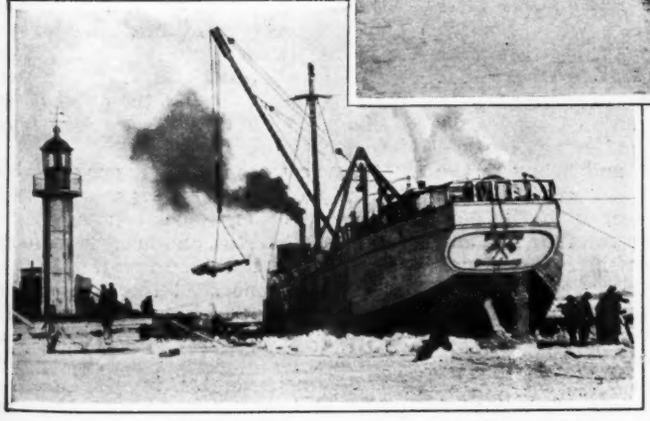


The pulpwood "trapper," invented for Anticosti—a sort of steam shovel for wood. The shovel picks up a cord and a quarter at one bite



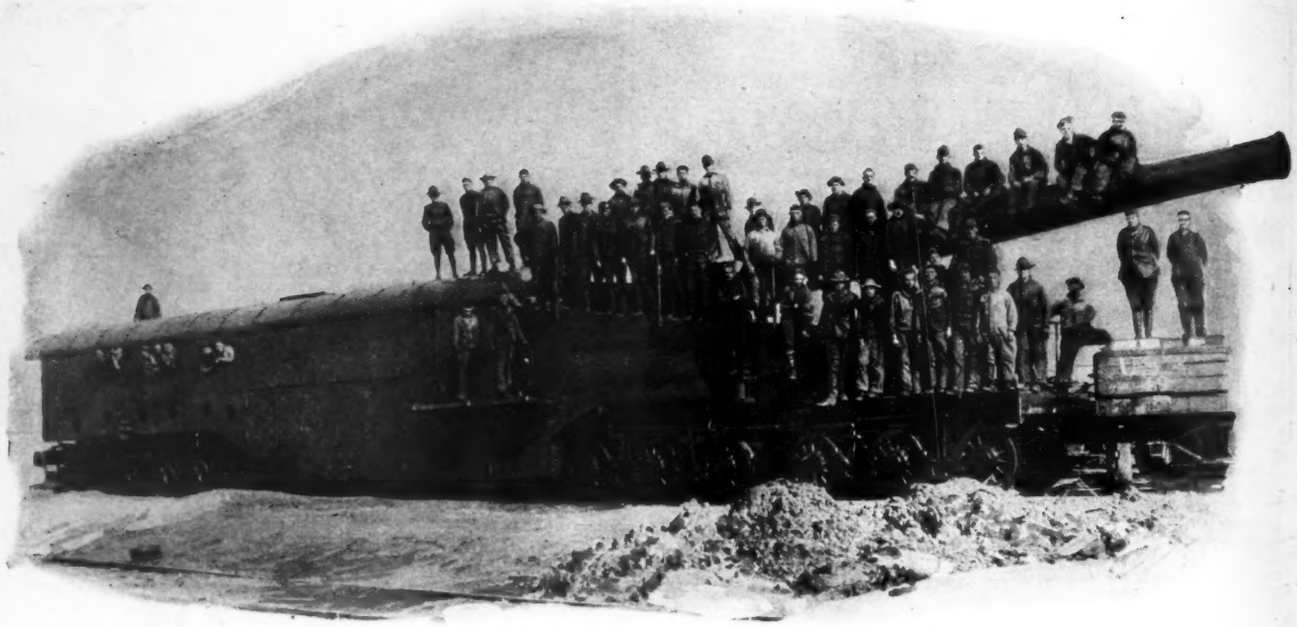


The "trapper" invented to plunge into the concentrating basin, where a sea of logs in 4-foot lengths is about 4 feet deep. The "trapper" fills with logs as if with water. Then the operator shuts it and hoists



Unusually built pier at Port Menier, where work goes on the year round to improve and extend facilities to harvest the 12,000,000 or 15,000,000 cords of pulpwood and one of the island's peculiar ships used for this work

One of the powerful caterpillar tractors that haul trains of sleds loaded with pulpwood through the snows of Anticosti. These machines make it possible to do some harvesting of the wood even during the winter time



One of the battleships on wheels with its crew, photographed after its assembling at St. Nazaire, France, just before it left for the front to hurl 1400-pound shells

Our Battleships on Wheels

How American Navy, Firing "Off the Map," Shattered and Set Aflame Germany's Vital Rail Centers, Hastening Victory

By REAR ADMIRAL CHARLES P. PLUNKETT, U. S. N.

In Collaboration with THOMAS M. JOHNSON

In this, the third and final part of the amazing story of the American Navy's long-range guns that helped turn the tide of World War battle against the German, Admiral Plunkett, who commanded the guns, and Mr. Johnson, who as a war correspondent watched their campaign, reach a smashing climax.

ON THE war map you stuck pins in ten years ago, Laon was northeast of Soissons, with so many radiating railroads that it looked like a spider. Gun No. 1 cut off the spider's legs in eight days' bombardment, though news came at the end of the first day that the German retreat from before Laon was commencing.

That was September 28, and we had just given the Germans a continuous performance from 1:00 until 5:30 in the afternoon. We only stopped then because it was dark and they could easily locate us by the great flash the gun made. We had dropped forty-seven fourteen-inch shells at 34,320 yards on their railroad sidings—about one every six minutes. On September 30 we commenced at 11:57, fired five shots, knocked off for dinner, and between 2:36 and 6:27 fired twenty-five more. Enemy airplanes came over, looking for our exact position.

NO WONDER. Nothing so big as our shells had ever before burst in their midst.

On October 1 the Germans threw more shells into St. Christophe cemetery. We squared up next day by dropping thirty on the Laon west railroad.

We had hooked up our telephone to a French sausage balloon and on October 3 we began firing with airplane observation. We fired ten shots, and the observer saw six land, two on the military railroad we were after. We knew that meant a tie-up on the subway for the Germans, so at 6:30 we knocked off, having thrown nine more shells after correction by the observer's reports. Next morning German shells landed between us and Soissons. We sent the ammunition cars into safe retirement.

ON OCTOBER 5 the Germans cracked down on us hot and heavy in the afternoon, and again in the evening. One shell struck sixteen feet from the gun, and fragments cut the train air line and broke off a piece of casting. One struck a clothes bucket in which a gob had been doing his washing. We sent the men back out of danger and moved the gun back. The Germans, unaware, opened up again in the evening on our old position.

The total damage was nil, but next time we might not be so lucky. We dug holes for ourselves, and made dugouts near the gun to hold fifty men.

Our battleships on wheels drew a lot of attention. Allied officers were continually inspecting them and military visitors bothered our firing until we had to build a rope fence around the gun. American Congressmen visited us, and one wrote his name on a shell before it was fired. Our most delightful and delighted visitors were French and American nurses from a hospital at Villers-Cotterets that the Germans were bombing, who came to see us get even.

OUR two guns fired every clear day and some that weren't. Gun 1 on the Laon railroads, Gun 2 on Mortiers, until at dinner time October 12 the French sent word their infantry were entering Laon. To see the effect of our shelling, Ensign Roger Allen and I followed on October 14.

It was easy to tell where our shells had hit. No other shell holes were so large and deep as ours, which averaged forty to seventy feet across, and in some we found fragments that we recognized. We found the nose of one shell three miles from where the shell had exploded. One hit was enough to wreck a three-track railroad line for at least 100 feet, blowing an enormous crater in the roadbed. Although the Germans had repaired the damage at night, their use of the railroads had been greatly curtailed. A freight train was on a siding just as it

had been struck, one car thrown on top of another, a third thrown thirty feet. Three shells had wrecked completely a storehouse used for electrical material.

The French people told us that the Germans had a large moving picture theater in Laon, always crowded with soldiers. One shell struck it. Forty Germans were killed and sixty severely wounded.

We found that when we had fired "off the map," shots were almost always effective hits, but where we had airplane observation and applied corrections, later shots were perfectly placed. We had airplane observation on only about ten percent of the 782 shots we fired in France. The fall of only twenty-three of Gun 1's 199 shots could be observed; many more shots called "unobserved" were fired following corrections and these were usually direct hits.

SHORTAGE of aircraft or necessity of firing on cloudy days were the usual reasons for firing off the map. And an observation aviator up 5000 or 6000 feet had his troubles. Not only did German antiaircraft artillery and fighting planes make special effort to get him, but often on a seemingly clear day a ground mist made it impossible for him to see shell bursts. One French aviator worked against a sixty-mile gale that blew him over the German lines and had a hand and his face frozen.

Rear Admiral Charles P. Plunkett, commander of the American Navy's famous battleships on wheels

Longuyon, vital center of German strategic railroads, which was demoralized by shells fired from U. S. Naval guns 23 miles away in the critical period of Meuse-Argonne battle. Photo shows Americans moving in after the Armistice

Firing off the map is not hard for anyone who has been a navigator. We considered the problem a dead reckoning course and distance calculation. We used only a map showing the vicinity of the gun position and another showing that of the target position.

TO OVERCOME the difficulty of representing a spherical surface like the earth on such maps a projection called the "Lambert projection" was used to give a correction applied to astronomical observations of sun or stars or of polaris by theodolite, to obtain a "Lambert bearing"; by this a traverse could be run over the gun sight to orient the gun according to the Lambert system. You wouldn't think you would have to take solar observations before you could shoot up Germans—sounds like astrology.

Another curious thing about our battleship on wheels was that we got weather reports radioed frequently from stations along the front. These gave in code barometric pressure, temperature, force of ballistic wind, its direction, and height of observing station. They got wind direction by watching small free balloons rise and drift. At night the balloons were loaded with powder, set to explode at different heights, and their positions in the air determined by sound ranging. That is one of many illustrations of the complicated and scientific procedure of firing long range guns.

Of course, to fire a 1400-pound shell as far as 48,000 yards at something you can't see, going up 35,000 feet into atmospheric conditions that must be largely guessed, is a real task. But miraculously,

One of the dugouts that sheltered American gobs in France from the answering shells of the Germans while the Americans were wrecking enemy railroads with the biggest guns that France had ever seen on land. This artillery duel lasted more than a month, when the war ended

we found the range error averaged only 151 yards and the deflection error only fifty-one, and, as most of our targets, such as railroad yards and ammunition dumps, were of great extent, and as one gun fired as many as fifty shots in one day, we believed we had worked out a method of scattering shots so as to do the greatest possible damage. Commander Schuyler has suggested that a mathematician might discover how long-range guns without observation can do the greatest damage. That would be something worth knowing in the next war.

In the last one we marked off about 400 meters beyond the near edge and 400 before the far edge of the target, then drew lines 200 meters inside the right and left edges. Within that area we drew a spiral on which we marked one point for each shot to be fired, putting more in the middle. Then we would calculate each shot to fall on one of these points. It worked so well that General Mangin was well pleased.

The headquarters of this celebrated French general were only a few hundred yards from one of our gun positions. Once I was at dinner there when an orderly brought a note and the General and his Chief of Staff went into the next room where the maps were. When they returned, the General remarked:

"Well, Admiral, you have been making a good deal of noise with your guns. Now it is my turn to make some."

In a minute or two there was a deafening crash as every French gun for miles, it seemed, burst into action. For perhaps a half hour they fired continuously, the general meantime talking on about other things. He only nodded when a second note told him a strong German counter-attack had been repulsed.

AS SOON as General Pershing heard that we had definitely succeeded, he sent for us to help win the biggest battle in American history and the last days of October saw our highest ambition realized—all five of our battleships on wheels assembled in a "fleet" under immediate command of myself, an American admiral, working with the American Army to win the war. Another proof that we had made good was an order to the Navy designers in Washington to commence planning a new gun car, using the lessons we had learned, to carry a second "fleet" of five guns to France. Before they got there the war was over.

Our guns were in at the death. Under the hammer blows of all the Allied armies, the Germans were retreating slowly from Belgium and Northern France. The pivot of their retreat was the Meuse-Argonne region north of Verdun, where the Americans were attacking. Here General Pershing was trying to reach a web of railroads of vital importance to all the German armies.

These lines connected the Rhine and Germany with the front in France by way of Metz, Montmedy and Sedan, all big railroad depots. Montmedy had a large railroad yard usually filled with cars. It was on the main line from Metz to Sedan. It was headquarters of the German Seventh Army. All the railroads in the locality were part of the German solar plexus and you couldn't cut one without making trouble for all. Our secret field orders from Brigadier General William Chamberlaine, the American heavy artillery commander, said:

"The towns of Montmedy, Longuyon, Spincourt and Conflans-en-Jarny are among the most important railroad centers of the enemy's transportation system for the supply of the Western Front.

"A GROUP of long-range guns more powerful than heretofore assembled for a single operation is now being emplaced to attack the above centers."

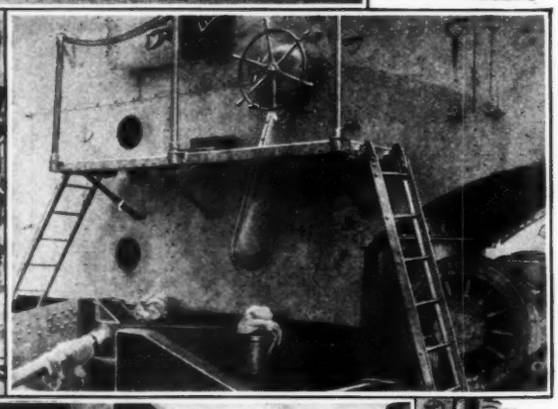
So we started out to do it. The place selected was the nearest point on the front to Longuyon and Montmedy, where they had built the curved tracks from which our guns fired. At Thierville, two miles northwest of Verdun and at Charny, three miles north of Thierville, both rather hidden among the heights of the Meuse, were our positions.

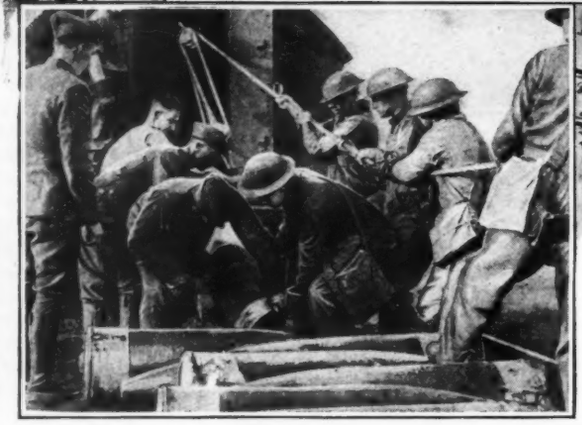
The first guns to get there and join the American Army in battle were Numbers 3, 4 and 5, which came up from Haussimont without many Jonahs for their first trip to any front. Pits were dug at Thierville and Charny for guns 1 and 2, en route.

The same day that I was counting the big holes Gun 1 had made around Laon, Guns 3, 4 and 5 were digging their pits at Thierville, nearly 100 miles southeast. A couple of days later the Germans gave the village such a shelling that Lieut. J. R. Hayden took fifty cans of powder in out of the wet and put them in a bombproof.

At 12:22 on October 21 Gun 3 fired the first shot, and just one hour later six German airplanes were flying overhead, and about 4:30 seven shells fell near the gun.

On October 23 Guns 4 and 5 fired one shot each, ranging on Longuyon at about 38,500 yards, and (*Continued on page 153*)



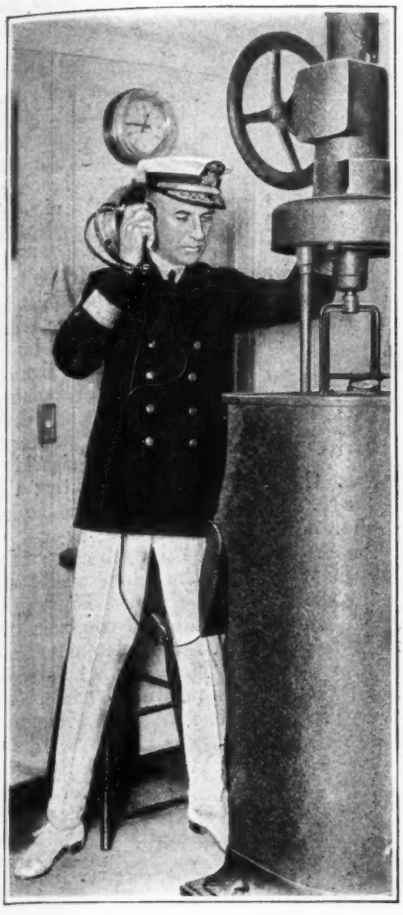


Top photograph: One of the American naval guns that helped make German retreat almost a rout, wrecking railroads, ammunition stores and headquarters. Middle: Pit and foundation under gun that permitted maximum elevation and range of 42,000 yards with old shells, nearly 50,000 with new, which never reached France. Bottom: loading ammunition car. Drawings show a berthing car and the shattering of a train

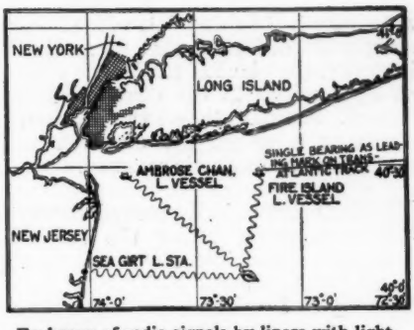
Robbing Fog of Its Perils

Waves of Radio and of Light and Sound Guide Planes and Steamships Through Blinding Vapor

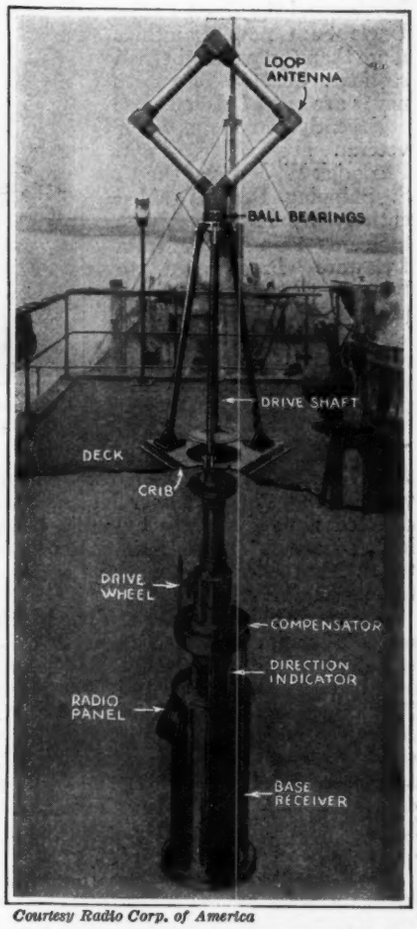
By
NORMAN C. McLOUD



Commodore Hartley, *Leviathan's* master, taking its bearings with radio compass. He rotates the antenna loop above deck until signals from the beacon are weakest. Then the indicating device shows ship's exact position



Exchange of radio signals by liners with lightship and light station and with each other show their positions and guide them into port



Courtesy Radio Corp. of America

The "ears" of the radio compass—the ball bearing rotatable loop antenna, mounted on deck and controlled from the pilot house by a shaft. The loop consists of a number of turns of wire inclosed in water-tight tubes

WE WERE nearing the American coast in a fog which had blanketed us a good part of the way across the Atlantic. For three days our ship had barely crept, continually sounding its mournful warning whistle. Now a chorus of whistles from other craft indicated we were in the vicinity of New York harbor. But where?

The engines stopped, anchors went overboard, and for eighteen hours the big liner lay there, afraid to move.

"I don't know just where we are," the skipper explained. "But we've gone as far as I'm willing to go in this pea soup."

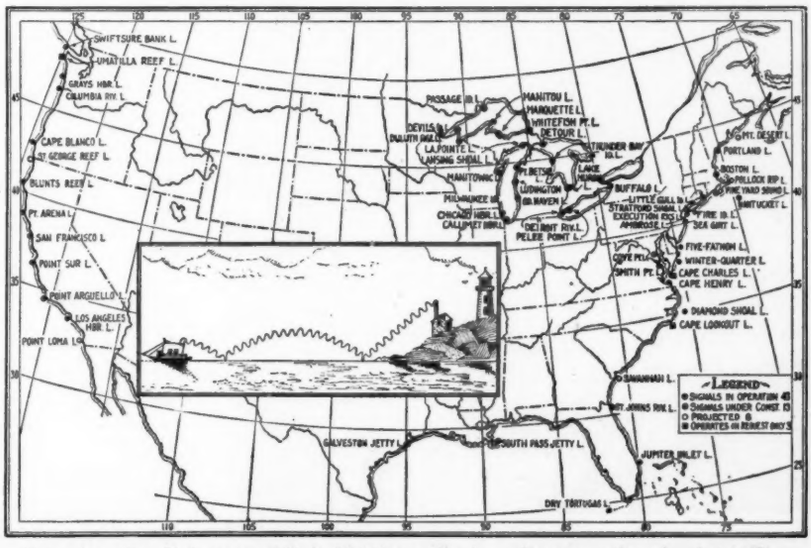
That was less than ten years ago.

Recently I was bound from Bordeaux to New York on another ship—and in a fog as thick. Yet as we approached Nantucket Shoals there was no lessening of speed. When I sought an explanation, the skipper, a seasoned Scot, invited me into the chart room. "That's the answer," he said, pointing to two colored pencil dots touching each other on the chart of our run. They indicated the ship's position.

"We had a glimpse of a few stars just before daylight," he explained. "That's where we got the blue dot. About the same time we picked up direction signals from a coast radio beacon. That's where the red one came from. You see, we can't go far wrong."

In those merging dots was written a remarkable story of the use of waves of radio, light, and sound to banish within the last decade much of the old terror of fog at sea, on land and in the air.

Newest of these triumphs are the radio beacon and radio compass. Radio beacons of the U. S. Lighthouse Service radiate wireless signals, and a single beacon enables the navigator to steer a safe course, even when fog completely shuts off visibility. Signals from two or more beacons in divergent directions enable him to chart his position accurately by triangulation of cross bearings. Moreover, the compass will tell him the

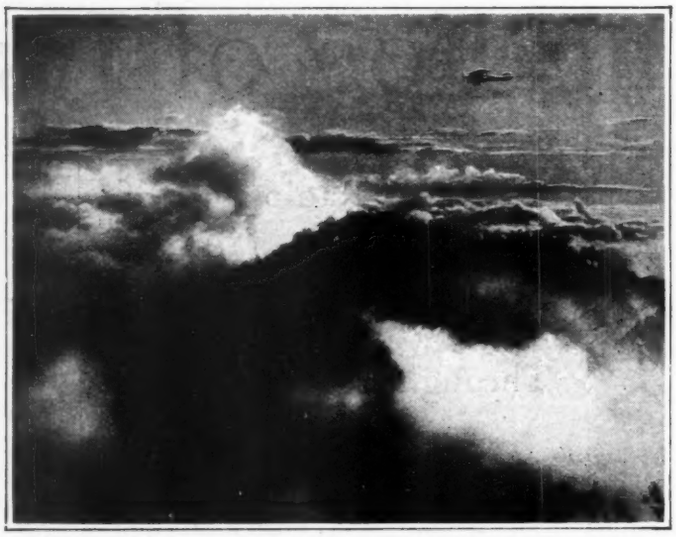


Dots show 59 radio beacons of U. S. Lighthouse Service, whose operation the sketch illustrates. Of these 43 are in operation, 3 operate on request only and 13 are under construction

location of another vessel hidden in fog, by determining the direction of her wireless signals.

Along the Atlantic and Pacific coasts, the Gulf of Mexico and the Great Lakes, Uncle Sam now maintains more than forty radio beacon stations. Coastwise steamers never are out of their range.

Recently, for example, a veteran shipmaster, Capt. Frederick W. Jones of the U. S. Shipping Board, guided entirely by radio compass, took his ship safely from Delaware Breakwater to Boston—all the way through heavy fog—though his route lay along Nantucket Shoals and around Cape Cod reefs where many a vessel has come to grief.



Fog over the mountain range no longer terrifies the aviator, for signals from radio beacons tell him if he is on his course or if he is at the left or right of it

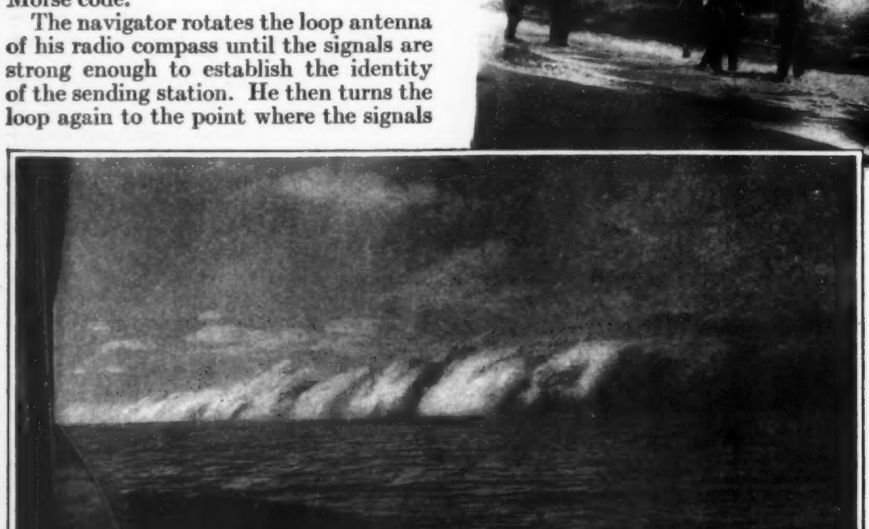
NAVIGATED once from New York to Boston through enveloping fog, the great liner *Majestic* was directed almost entirely by radio bearings, so accurately that she passed between Nantucket Lightship and a nearby marking buoy!

Most large ships now are equipped with a radio compass, which is used continually not only to take bearings but to avoid collisions. In heavy fog off the Pacific coast the steamship *H. F. Alexander* not long ago picked up the wireless signals of the steamer *Everett*, a slower vessel, showing the *Everett* directly ahead. Thus, as in many like instances, a disastrous collision was averted.

The radio beacons, with equipment much the same as that for ordinary wireless transmission, send out signals automatically at regular intervals by a motor-driven mechanism. Each beacon has its own identifying signal—a certain simple combination of dots and dashes of the Morse code.

The navigator rotates the loop antenna of his radio compass until the signals are strong enough to establish the identity of the sending station. He then turns the loop again to the point where the signals are weakest. At this point, which is more sharply defined than that of maximum intensity, the plane of the loop is exactly at right angles to the direction of the beacon. An indicator on the instrument shows at a glance the direction with relation to the magnetic compass.

RADIO dramatically proved its worth as a guide during the flight of Amundsen's dirigible *Norge* across the North Pole two summers ago. Bearings



A fog bank rolling in on the sea to test the powers of modern science in guiding shipping. Above: Coast Guardsmen burning flares on the Massachusetts coast to aid in making rescues from a ship wrecked in a dense fog. In emergencies primitive methods still often serve. Seven men were saved

lost in a thick fog, the ship was in grave peril when its radio compass picked up signals from the wireless station at Nome, Alaska, turning possible disaster into an epoch-making achievement.

THE Government's present program calls for radio beacons at 200-mile intervals along the country's main routes. Unlike the marine beacons, however, these send out directed beams of radio signals, like the beam of a searchlight, along the course to be traversed. For an air pilot to follow the path of the beam is simply a matter of interpreting Morse code signals. If the plane is on its course, the signal is the single dash of the letter T. If the course is to the right, the signal becomes the dash dot representing the letter N. If to the left, it becomes the dot dash of A.

An elaboration of this system, recently introduced along the Government air mail route between New Brunswick, N. J., and Cleveland, O., combines the radio beacon with radio telephone facilities for the pilot. Not only is he guided, but he reports his position by telephone every five minutes. Another improvement, developed by the Radio Research Board of Great Britain, is a device which translates the radio waves from a beacon into light waves that are visible on the fluorescent screen of an oscillograph in the pilot's cabin.

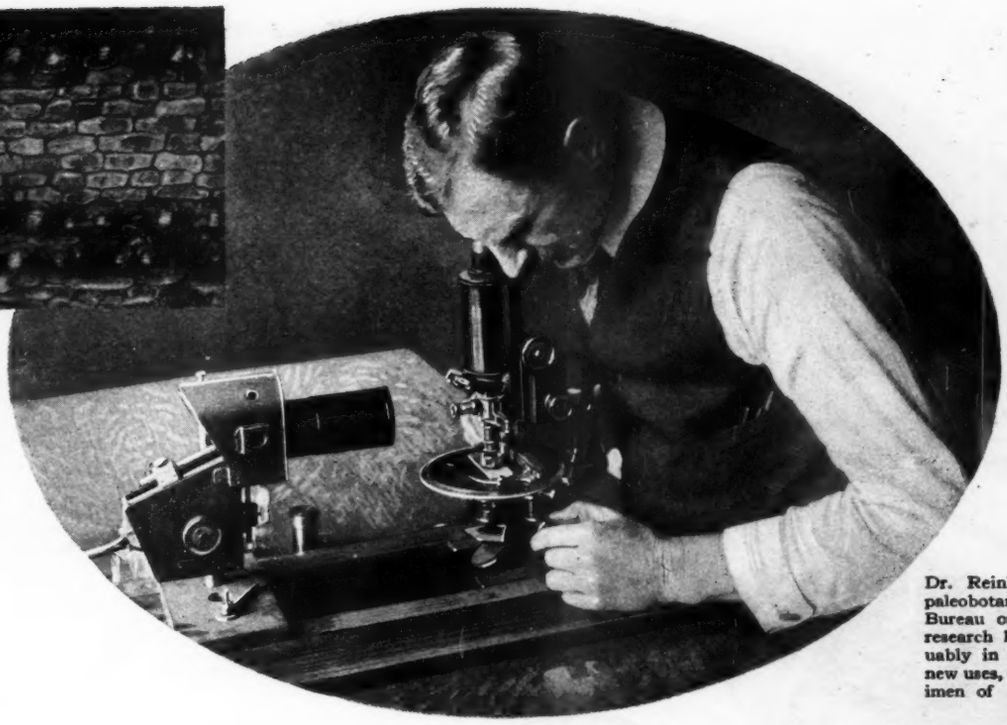
FREDERICK A. Kolster, inventor of the radio compass, has gone his own device one better with a "mobile radio beacon." This actually is a "radio foghorn" for ships, in the form of a low power automatic radio transmitter which sends out a characteristic signal audible for ten miles.

Of late, however, inventors have greatly increased the efficiency of audible fog warnings. One important advance is in the transmission of sound under water, where it travels with much less variation than in the air. Many submarine bells have been installed along our coasts. Ships pick up the submarine signals by means of microphones, placed below the water line.

Light signals, likewise, have been greatly improved. A powerful new ray which penetrates dense fog is supplied from vacuum tubes by neon gas.

To safeguard the passage of vessels through rock-ribbed channels, underwater beacons have been developed. These consist of submerged searchlights powerful enough to reveal hidden perils no matter how dense the fog.

Bituminous specimen, magnified 200 times, shows formation that proves that it originated as plant life



Dr. Reinhardt Thiessen, paleobotanist of the U. S. Bureau of Mines, whose research has aided invaluably in putting coal to new uses, examines a specimen of bituminous coal

Coal Too Useful *to* Burn

Chemists Already Make Bituminous into Medicines, Dyes and Fertilizers and May Make Tile and Rubber

By A. C. FIELDNER
Chief Chemist, U. S. Bureau of Mines

EVERYONE who has tried to keep clean in any neighborhood when soft coal was burned will be interested to know that research chemists in the Pittsburgh Experimental Station of the U. S. Bureau of Mines are busy, at the present moment, making it smokeless. Literally, they are knocking the tar out of it!

More important, in so doing they are discovering new ways to change the smoke into valuable new products that everybody can use. Already—and their work has just begun—they have found how to extract from coal tars valuable material for preservation of wood and excellent antiknock fuel for automobiles.

The experiments are but an indication of how scientific research is swiftly revolutionizing the world's use of coal resources, and thus changing the whole face of industry.

At present, of the 578 million tons of bituminous mined annually in the United States, ninety percent is burned for heat, light and power, without recovering any of its precious by-products. The other ten percent is converted into gas and coke. From two thirds of this, other by-products such as tar, ammonia, and light oils are recovered.

AT THE present rate of progress, however, we may expect to see the ratio reversed before many years. Comparatively little coal will be shoveled into the fire. It will be deemed too valuable as raw stuff for the manufacture of vital necessaries of life, as well as a source of more efficient fuels. Even now the list of everyday things derived from coal runs into the hundreds, including dyes, fertilizers, explosives like TNT, medicines, drugs, solvents and preservatives.

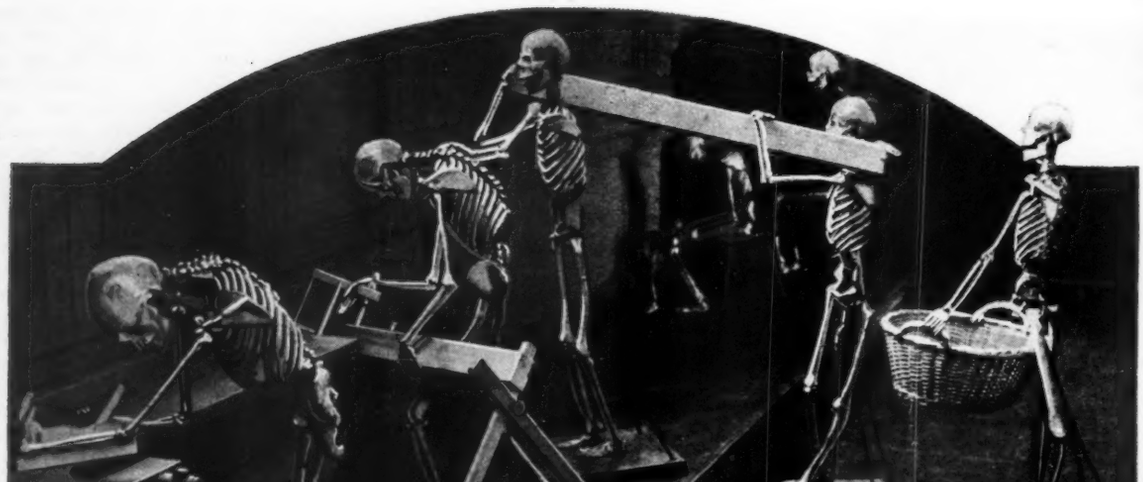
It took about a lifetime to build up Germany's great coal tar dye industry, based on by-products of coke manufacture. But, thanks to modern research laboratories, it required only a few years for Germany to develop the commercial manufacture of wood alcohol from water-gas—a product of coal and water—to the point where it rang the death knell of the great wood-distillation industry.

AND American chemists, in another two years, developed a process of their own which is now operating at Belle, West Virginia, in the heart of the bituminous field. Plans are being made to enlarge this plant to supply the entire American yearly demand of ten million gallons!

(*Continued on page 164*)

Courtesy of Carnegie Institute of Technology

Making methanol from coal and gas by the Patart method. Under pressure and heat in cylinders zinc and chromium compounds change water-gas to wood alcohol



This is no nightmare, but a German health exhibit calculated to impress forever on people's minds the importance of maintaining correct posture. The skeletons are shown in the correct and incorrect attitudes for daily human activities at work as well as at play

Newest Harvest *of* Research

Skull of California "Ape Man" May Be Half Million Years Old—Heart's Electricity Photographed—"Death" of the Sun Predicted

Advances in many and widely diverse fields of scientific research, discoveries, inventions and theories, important because of their bearing on everyday life, are chronicled each month in these pages.

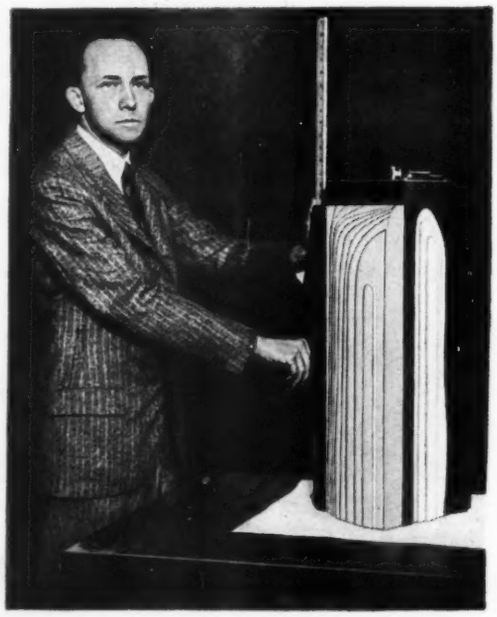
Sun's Collapse Predicted

A GREAT British astronomer, Professor J. H. Jeans, says the sun is ready to collapse at any moment. When it does, the earth will be frozen so cold nobody can live on it.

A French astronomer, M. F. Baldet, finds evidence that the planet Jupiter, largest in the sun's family, is shooting enormous volcanic bombs into space. Some of the comets and fire balls that sometimes hit the earth may come from Jupiter.

In our own universe of the Milky Way, and in countless others like it, such bombardments signalize momentous changes as time moves on.

Of the many stars in our universe system—possibly thirty billion—modern reflecting telescopes are capable of photographing three billion. Each is a sun. Most of them are larger and brighter than ours. Each sheds energy until it burns out. Stars at old age, called "white dwarfs," give little heat and light.



To determine the effect of wind on buildings, this and other models of skyscrapers are subjected to artificial hurricanes in a wind tunnel by the U. S. Bureau of Standards, as described in the February POPULAR SCIENCE MONTHLY. By varying the pressure on various parts of the structure it is possible to find where it is too weak and where unnecessarily strong. The tests are invaluable to builders

Professor Jeans calculates that our sun is perilously near the "white dwarf" stage. Any day it may totter. But, since a day in the universe may be millions of years, this is nothing to worry about.

America Man's Birthplace?

WORKMEN, laying a sewer in Santa Barbara, Calif., found a skull buried eighteen feet a few weeks ago. To them it was only a somewhat gruesome mass of bone; but to Dr. A. H. Ousdal, an archeologist, it was a rare historic document. For his examination indicated, he said, that the skull was the nearest thing so far found to the "missing link" connecting man and the apes with common ancestry. Undoubtedly, he said, it is older than the skull of the famous Java ape man believed to have lived nearly half a million years ago. The primitive ape man who possessed it could not have been able to speak except in grunts.

If Dr. Ousdal is right—and there seems excellent reason to believe that he is—the find will add important weight to the theory, recently advanced, that the birthplace of the human race was in the New World.

Oil Engine and Cheap Helium May Start New Flying Epoch

AVIATION engineers of England have perfected a new airplane engine of the Diesel type, which burns heavy oil in place of gasoline.

From the Fixed Nitrogen Laboratory, at Washington, D. C., comes the statement of Dr. Frederick G. Cottrell, expert on the chemistry of the atmosphere, that helium gas may be obtainable from the air in unlimited quantities.

These two recent developments have an important bearing on the advance of aerial transportation.

A successful noninflammable oil engine will remove the fear of fire that now stands in the way of public confidence in flying. The new engine delivers less power than a gasoline motor, but also reduces fuel consumption.

An unlimited supply of noninflammable helium for the safe inflation of airships would remove the most serious handicap to development of lighter-than-air craft. In ordinary atmosphere there is only one part of helium to 180,000 parts of air. But there is plenty of air.

Creeping Baby Is Trotter

A CAMERA, a cat, a bulldog and a nursery of babies were assembled recently in the psychological laboratories of Johns Hopkins University to determine what sort of stride babies use when they creep.

The answer was:

Babies are trotters.

Watched by the camera, the cat and the dog proved to be pacers, the weight of the body being alternately borne by the two legs on each side. The babies, however, in almost every instance kept their weight balanced diagonally between a leg on one side and an arm on the other, in the manner of true trotters.

Dr. Lenoir H. Burnside found that usually the first attempts at locomotion consist of flounderings and waving of arms or legs. Later the baby's arms begin to work alternately while the legs are still dragged. At last the infant raises his body and strikes out in a trot.

Photos of Heart Electricity

PHOTOGRAPHY'S latest achievement, announced by Dr. C. E. Kenneth Mees, Director of Research in the Eastman Laboratories, is in recording faint electric currents of the human heart! The process, employing a string galvanometer, a delicate instrument for measuring electric currents, promises usefulness in diagnosing heart ailments.

Deaf children's voices are transformed into light waves so that they may see what they say and improve their articulation. The sound waves, striking the receiver diaphragms, set up tiny currents in an electric circuit, which causes beams of light, reflected through mirrors, to represent the sounds exactly as they were uttered

Only by wearing open-weave fabrics can you get appreciable benefits from the sun's ultra-violet rays, according to tests made by this device recently in the U. S. Bureau of Standards. Only rays passing through the meshes have sufficient healthful action. The solid part lets through only five to ten percent. Dyed and aged thread let through the least, says R. Stair, who is pictured making tests on various samples in the Bureau's laboratories

Accidents Due to Blood

THE reason some auto drivers constantly have accidents while others have little trouble may be largely a matter of blood pressure.

Dr. Walter V. Bingham and C. S. Slocombe, psychologists of the Personnel Research Federation, New York City, have just completed experiments in which they find a definite relation between health and motor accidents. Among bus drivers and motormen more than fifty years old, men with high blood pressure were found to have more than twice as many accidents as those with normal pressure.

This excessive pressure, the psychologists say, apparently affects health and temperament to a point where it interferes with safe driving. Their investigations also showed that the longer a man drives the fewer accidents he has.

The towering new tobacco plant developed by Professors T. H. Goodspeed (left) and A. R. Olson of the University of California by the action of X-rays on sex cells of the parent plant from which the giant was produced. The common tobacco plant is shown between them. Their experiments confirm those of Prof. H. J. Muller, noted in this magazine last month

Mummies Sought in Arctic

MUMMIES of long-forgotten men of the Far North, older than those found in ancient Egyptian tombs, will be sought by an expedition of the American Museum of Natural History, this spring, exploring the Arctic Coast of Siberia.

The remains are those of primitive Mongolians, believed to have been the first settlers of North America. Their existence was reported by the late Dr. William H. Dall of the Smithsonian Institution. For thousands of years they have been preserved by Nature in caves in the Aleutian Islands, where they were buried. They are believed to date to the postglacial period.

Natives of the Aleutian Islands believe the mummies hold a curse, and fear to go near them. It is related that a Swedish fisherman who attempted to remove a mummy to the United States in a boat was never heard of after he set sail.

This year's expedition is led by Harold McCracken, who has spent five years in the Arctic.

Insects Turned into Metal

SOME months ago a German chemist, Dr. N. D. Zelinsky, was making chemical analysis of certain insects. The process involved covering them with powdered copper oxide and heating them in small platinum crucibles in an atmosphere of carbon dioxide. He was astonished to discover that the insects turned to metal, with the delicate markings and structure preserved. As a result, museums may preserve rare specimens indefinitely.

The "road yacht" touring car with living accommodations for five persons. Below: luncheon from the "galley" is spread for the auto's driver

"Road Yacht" Complete Home

THE man who drives with one hand will find that he may use the other to reach for a sandwich and a cup of coffee in a "road yacht" developed in London.

The vehicle, which looks like a large metal bug on wheels, is the latest in touring luxury. Speed of forty-five miles an hour may be easily attained. An electric "galley," completely fitted lavatory, two sleeping cabins, book shelves, writing tables, and a radio complete the equipment of this automotive innovation, which accommodates five persons.

Big New Meteorite Studied

WHAT is thought to be the largest meteorite preserved intact for which the date of fall is definitely known is being studied by experts at the University of Iowa. It is a 110-pound chip from a celestial visitor that exploded about fifteen miles above Iowa City, Ia., according to Prof. Charles C. Wylie, one of the investigators. The chip buried itself in hard clay.

Bottle Traces Ocean Current

A FLOATING bottle's journeys ended the other day when William Hannapin, walking along the west coast of Ireland, picked it from the water and read the note it contained, "No. 1059. Please return to William Beebe, New York Zoölogical Park; or to the Hydrographic Bureau, Washington." Nearly a year ago the noted explorer Beebe had thrown the bottle into the Caribbean sea 2800 miles away; the Gulf Stream had carried it to its journey's end.

More than a thousand such bottles were dropped by Beebe during this cruise. Thirty-one were recovered, mostly from Central American shores, but this one revealed caprices of ocean streams.

How to Name a New Animal

IT'S harder to name a new animal than a new baby, according to Dr. C. W. Stiles, secretary of an international commission that has sought for years to work out a standard naming procedure. The creature runs the risk of being named several times by independent discoverers.

According to the commission, if you discover a new species of bird, beast, or butterfly, you must publish the news of your discovery and give it whatever technical Latin name you wish. This alone, rules the commission, is the name by which it will always be known. Commencing with 1931, you must not only name it, but also describe it so fully that no other species may be mistaken for it.

Nearly half a million species of animals have been named since the pioneer studies of the great naturalist Linnaeus, says Dr. Stiles.

Saw Uses Sand to Cut Rock

A LONG steel cable, drawn at high speed and fed continually with wet sand, cuts through solid rock in a new type of quarry saw developed by Dr. Oliver Bowles, of the U. S. Bureau of Mines. Tiny grains of sand, dragged across the rock face, serve as abrasives to groove it at a rate hitherto unknown. In Pennsylvania quarries the device, known as a wire saw, cut quantities of rock without need of the costlier methods of drilling, blasting, and cutting.

Swastika May Trace Races To Lost Pacific Continent

MANY thousands of years ago there stood in the Pacific Ocean a continent where thrived a remarkable civilization. In a tremendous earth upheaval the continent vanished, swallowed by the waters. But before the catastrophe, adventurers from that lost land drifted to other continents and left their marks.

Such is the fascinating theory advanced by Col. James Churchward, of India, to explain the origin of mysterious symbols found carved and painted on rocks.

Most famous of the symbols is the swastika cross found on rocks in America, Asia, Europe and Africa. In North America the rock writings, or petrographs, have been generally attributed to comparatively recent tribes of Indians. Colonel Churchward, however, contends that many of them are very ancient, and that their original source was the lost continent. With the aid of key symbols discovered in India, he claims ability to translate some of the mysterious writings.

Interest in tracing the family tree of modern man has been heightened by the recent statement of Dr. Ales Hrdlicka, noted anthropologist, that the low-browed grisly Neanderthal man, who lived some 40,000 years ago, may have been our direct ancestor, instead of a distant cousin of a different species. The belief has been that this prehistoric race was exterminated by the later Cro-Magnon men and left no descendants. In the remains of Neanderthal man, however, Doctor Hrdlicka finds new evidence that he formed a definite link in the long chain of human evolution.

Motorcycle Drives Sea Sled

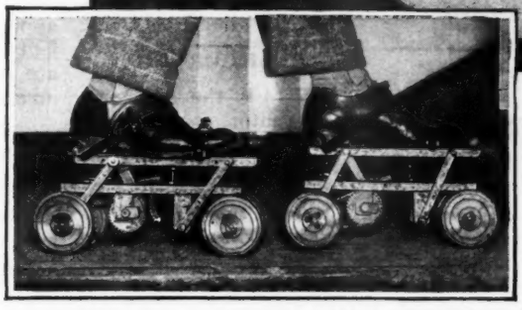
HOW would you like to go for a motorcycle ride on the river? E. A. Cullum, pictured below, thinks river cycling a plausible idea even though his first attempt to cross the Thames resulted in the sinking of his queer machine and the second fared little better. His vehicle consists of a motorcycle built into a float of the sea sled type.

With a motorcycle built into a sea sled, E. A. Cullum has a remarkable water craft, which runs on tranquil surfaces, but the Englishman's efforts to cross the Thames River have so far been unsuccessful

Gear-Wheeled Roller Skates

SKATES like those seen below would allow you to drink that extra cup of coffee and still get to work with time to spare, for the remarkable speed of thirty miles an hour is claimed for them. The effective motive power for these up-to-date "seven-league boots" is furnished by the downward step of the skater through a ratchet gear wheel. Springs that operate automatically return the carriage to the original position ready for the skater's next stride.

The name of "walking machinery" was given to the skates when they were shown at the International Inventions Exhibition at London. The novel skates proved to be one of the most popular of the many interesting exhibits.



Thirty miles an hour is claimed for roller skates, called walking machines, which are driven by ratchet gear wheels that act whenever you take a step

Self-Sprinkling Roads

CLAY roads are kept moist, firmly elastic, and free from sun-dried cracks in Michigan by the addition to the clay used in building them of an odd chemical that absorbs water from the air. The resulting compact mass stands up well under ordinary traffic, according to A. L. Burridge, of the State Highway Department, who developed the novel idea.

Calcium chloride, the chemical used, has already proved its usefulness for gravel roads as well. Used in the top dressing of gravel, it renders the road dustproof. No water wagons need sprinkle the highway, for the grains of the chemical seize droplets from the air itself. Six tons of the chemical are used on each mile of road.

Sea Lions Caught with Nets

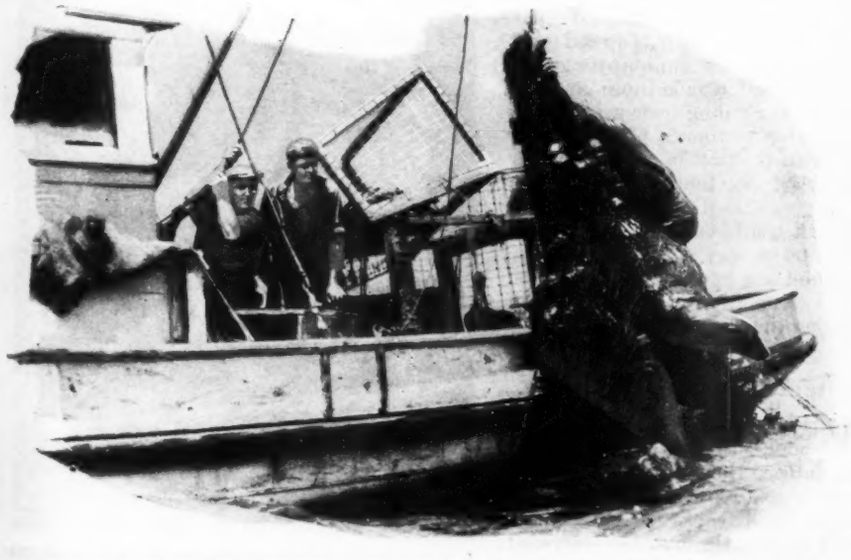
THESE seals and sea lions are said to be experiencing a new sensation, for heretofore, it is declared, this type of animal has never been caught and brought in with nets. The picture below shows a small schooner off the west coast of Mexico with what is reputed to be the first haul of this kind, made with netting of tremendous strength.

Five-Mile Road of Gold Ore

WITHIN the concrete paving of a five-mile stretch of Colorado road, just laid, lies $20,000 worth of gold. Highway engineers found that rock from mine ore dumps was the nearest at hand and most plentiful for mixing the concrete. Despite the quantity of gold it contained, there was not enough to pay for the expensive process for its extraction.

How Colors Aid Eyesight

ARTIFICIAL blue light is best for close work, an investigation reveals. Red is preferred for seeing distant objects; ordinary white for all-around work.



The first seals and sea lions ever caught, so far as known, in nets, hauled in by a schooner off the coast of Mexico. Special netting of tremendous strength is said to have made the feat possible

Junk Makes Queer Golf Links

HAVE you a dump heap near your home? If so you might lay out a golf course, for therein are the "makin's." Pipe fittings, a number of loose bricks, and a variety of crockery went to form hazards for this sporty nine-hole course that a large gas company at Hell Gate, N. Y., laid out in its front yard. Upon these links the player must be careful not to send his ball out of the yard with an unexpected bounce off a piece of steel tubing.

Dam Holds Water with Water

WATER holds back water in an amazing new type of dam, said to be extremely economical to construct, proposed by French engineers. If successful tests of a plaster model are confirmed, a 230-foot dam will be erected near Marege, France.

Instead of one solid masonry wall, the dam will consist of five thin concrete ones across the Haute-Dordogne Valley. Each, looking down the valley, is lower than the last, the farthest downstream being only forty-six feet high. When water is running over their tops they will appear like cascades.

Water fills the space between them, to make up the bulk of the dam. Its weight partly equalizes the pressure on opposite sides of each partition, unlike an ordinary dam that has nothing but its own strength to oppose the water's downstream push. Hence, the partitions can be made exceedingly thin with safety, and the total cost of the whole five is said to be far less than that of one massive wall.

Plan to Utilize Moon Power

PUTTING the moon to work for us is the not far distant prospect held out by the National Geographic Society, by the use of the same force that creates the tides and that makes the great liner *Leviathan* weigh ten or twelve pounds less when the moon is directly over it. "In years to come," the society announces, "this moon-force may be harnessed to create power; already plans are under way for the construction of tidal power stations."

Portable Track for Racing Greyhounds

Above: Releasing greyhounds for race on portable track. Below: Adjusting "electric hare" on wheel carrying it

Operator at the motor watches the race and, by regulating power, controls the speed of "electric hare," keeping it beyond reach of pursuing dogs

FLEET greyhounds vie for speed records as they pursue the "electric hare" of a new racing outfit, designed by an English inventor and recently successful in tests at Beddington. Though in design it resembles the standard race tracks that have popularized greyhound racing in Britain, the latest apparatus is portable and can be set up at any sports meet or fair.

At the starting signal the hare is set in motion; a second later the hounds are in full pursuit. Though the operator sees that they never catch the hare (for one was torn to pieces when this happened at Southend) they are spurred to great bursts of speed. Their quarry darts along in a lifelike manner at the side of its motive power—a car that is an electric motor on wheels, running along a miniature railway of narrow gage.

Electricity to run the outfit is generated by a gas motor and a dynamo.

Twin Panama Canal Foreseen

DO WE need another Panama Canal? Although the great waterway is now operating on a sixteen-hour schedule, it may eventually require constant use, indicates a report of the governor, M. L. Walker, to the Secretary of War.

During the last fiscal year shipping passing through the canal set a new high record of 5475 commercial vessels alone, not to mention other craft that brought up the average to nearly seventeen a day. Total cargo carried through the canal was nearly 28,000,000 long tons. Tolls exceeded $24,000,000. This is five times the traffic of twelve years ago; and if it continues to increase, enlarging of the canal or the digging of a supplemental waterway across Nicaragua may be necessary. Additional locks in the present canal, a suggested remedy, could increase its capacity only about fifty percent, it has been estimated.

Who Is Father Of Automobile?

THAT the real inventor of the gasoline automobile was Siegfried Marcus, Austrian mechanic, is the contention of authorities who plan a statue in his memory at Vienna. As early as 1864, it is said, the man who won the Golden Cross of Merit for incandescent lamps and rotary pumps he invented made the world's first motor car. Eleven years later he perfected a model and carried passengers. Not until 1885 did Gottlieb Daimler, the German, invent the gasoline engine that assured its success.

In the first engines the gasoline was exploded by heating the outside of a closed tube connected with the cylinder; it was impossible to time the explosions properly, since they lagged behind the piston's motion. Later the electrically ignited motor became forerunner of today's efficient power plants.

Paving Put to Test

HARD surfaced highways are the most economical to motorist and town or state alike, according to W. H. Rhodes, New Orleans engineer. "The efficiency expert of a tri-state bus company," he recently told the American Society of Municipal Improvements, "found that their heavy busses running over gravel cost two cents a mile more in tires than those running over asphalt. A conservative estimate of the saving in wear to the tires of an average car is at least six tenths of a cent a mile."

On all roads carrying more than 1000 cars a day, he declared, the providing of a hard surface would be a real economy, less costly than repairing the worn-down highway.

Wheels Made of Cotton

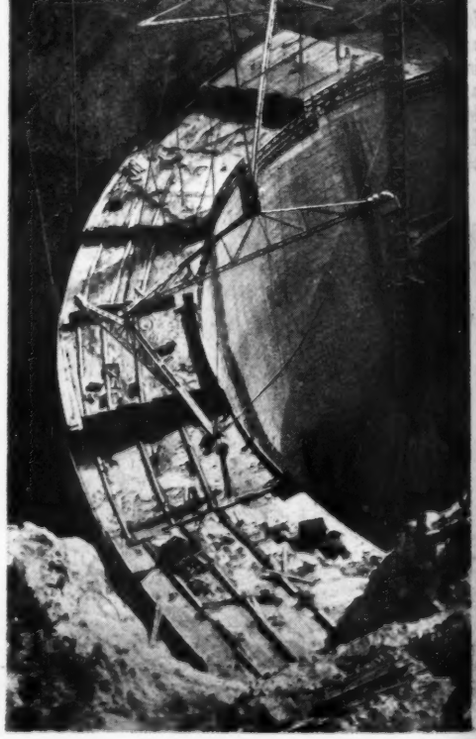
WHEN cotton manufacturers sought to find new uses for their fabric, they decided to make wheels of it! Now these odd wheels, used on hand trucks to enable them to roll quietly through factories and offices, have proved successful in recent tests conducted at the War Department. One of them, revolved against a grinding surface, showed no appreciable wear after running an equivalent of more than 350 miles. Experiments are being made to see if they can be adapted to automobile trucks.

Average Auto Lasts 7 Years

WITH average luck, you might expect your car to last seven years, concludes Prof. C. E. Griffin, of the University of Michigan, who investigated the history of 100,000 cars. Half of them were out of commission at the end of seven years, but, after twelve years, more than 5000 were going strong.

Dam Is Engineering Feat

THE great Pacoima Canyon Dam, three hundred and eighty-five feet high, six hundred feet long and a hundred feet thick at the base, considered one of the outstanding engineering feats of our time, will protect California's fertile San Fernando Valley.



A remarkable view looking down on the $2,500,000 Pacoima Dam, 385 feet high, which presented tremendous engineering problems and is two years in building

Mail Trapped by the Desert

TREACHEROUS at all times, the legend-famed Irak Desert of Mesopotamia becomes a sea of mud in rainy seasons, and motor cars attempting to cross it are trapped times without number like flies on flypaper. But mail must in spite of all circumstances traverse the forbidding wastes between Bagdad, in Mesopotamia, and Beirut, Mediterranean port of Syria. In the illustration the official mail is being "rescued" and sped on its way by sturdy natives, who are digging out a marooned transport car.

Navy Issues Ocean Air Maps

FOR the aid of trans-Atlantic flyers, the Navy Department's hydrographic office has commenced the publication of "pilot charts of the upper air," showing the most feasible aviation route for each month. They will be issued throughout the year.

Oil Ditch a Fabric Pattern

FASHION designers seeking new patterns may well turn to Nature, as the unusual photograph below shows. It is the chance shot of a photographer who saw in the curious mosaic of circles and ovals of an oil ditch an out-of-the-ordinary camera subject well worth recording. The striking record he obtained was one of the best exhibits at the London Salon of Photography.

Photograph by S. Uyeda

Formation of ovals and circles in many iridescent colors on the surface of an oil ditch—one of the loveliest pictures in an English exhibition

Building Wreckers Imitate Explosion

The collapse of buildings almost 100 years old looked like an explosion and sounded like one, being heard for blocks, when the ancient structures yielded to wreckers' sledges

NO, YOU'RE wrong, this is not a picture of an explosion, although it may look like one. In reality, the photograph was made when wreckers demolished several ancient buildings in Jersey City, New Jersey.

The old structures were almost 100 years old and very solidly built. The crash when they finally surrendered to the razers' sledge hammers was heard several blocks away. The buildings had been condemned, and were destroyed to make way for new construction.

Smaller Dollars Save Millions

TWO thirds the size of the old currency, the small new dollar bill just designed by the U. S. Treasury is expected to save the Government four million dollars a year. You will soon be carrying the new-size notes, which were scheduled to be ready by the time this magazine is printed—although it is said that half a billion will be printed before the first is issued.

Since twelve of these can be printed at once on a single sheet, as compared with eight of the old kind, the cost of printing is reduced. Another important feature, studies have shown, is that the smaller bills last much longer. They can be put in the ordinary wallet without folding. Ordinary dollar bills have an estimated life of eight months, before, limp and soiled, they return to Washington to be destroyed and made into souvenirs.

Making All Russia Gas-Proof

CIVILIAN inhabitants of Moscow, Leningrad, and other Russian cities—men, women and children—are now being provided by the government with "personal gas masks" and instructed in their use, according to reports. "It is our duty to supply them not only to every soldier but also to every working man and inhabitant of the districts behind the war front," Commissar of War Voroshilov told the Fourth Soviet Congress, urging that in the unlikely event of war Russia should not be unprepared.

Other suggested plans for protection against possible future air attack by gas include dwellings with gas-tight rooms, supplied by pipe with fresh air from plants with stacks reaching into the air.

Heating Plants on Roofs Next?

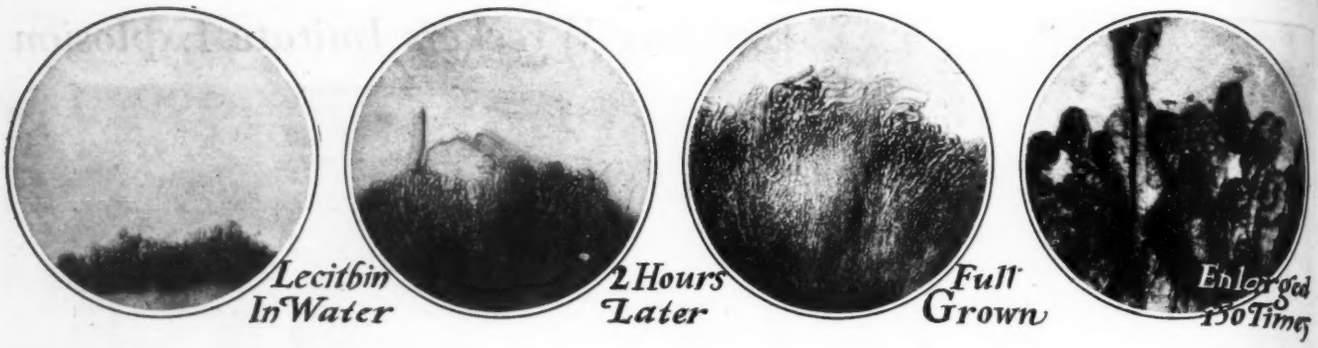
HEATING plants on the roofs of buildings may come within a few years, H. Leigh Whitelaw, of New York City, recently told the Pennsylvania Gas Association. Skyscraper owners, he said, would increase their profits by leasing the basements that now hold the heaters. The technical difficulties of adapting heating systems to the topsy-turvy plan could be overcome, he says.

Hens Smash Laying Records

FIRST place in the international egg-laying contest just conducted by the Washington State Agricultural College has been won by ten Barred Plymouth Rock hens owned by Prof. H. B. Densmore, of the University of Washington. In one year his pen of hens laid 2807 eggs. This is said to be the first time in poultry history that Plymouth Rocks have beaten all other hens, including Leghorns, which took second place.

Hotel Radio in Each Room

NOW the guests of a New York City hotel have radio programs on tap through the touch of an electric switch. The entire hotel has just been wired for radio, and two central receiving sets are on the thirty-first floor. Nearly all the 1600 rooms have loudspeakers.



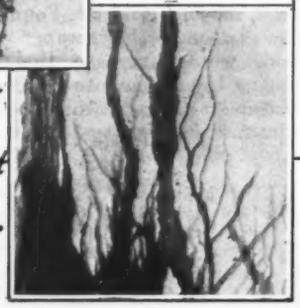
Plants Made by Chemistry

"Seeds" of Metal Salts, Put in Strange, Poisonous Solutions, Sprout Like Sea Vegetation

Fresh-Water Algae

Red Seaweed

Chloride of Iron Plant in Tumbler

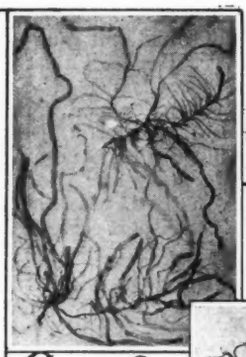


Chloride of Copper Plant in Potassium Ferrocyanide

NOW artificial plants are grown in test tubes through the chemist's magic. The photographs on this page, made by Dr. E. Bade, show how closely these chemical plants resemble nature's own products. Pills made of salts of metals are the "seeds," which are dropped into solutions of sugar or salt and other "nutritive" substances such as saltpeter and yellow prussiate of potash, a deadly poison. The pills sprout to form moss or tall stalks.

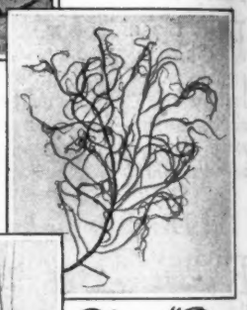
When lecithin, a waxy substance from the yolks of eggs, is placed in water, twisting threads shoot from it that appear under a microscope as grapelike clusters.

All of the chemical plants are easily mistaken for low one-celled plant forms. There is but one difference; they lack the vital spark of life.



Green Sea Algae

Branching Marine Form



Plant "Scum"

Chloride of Copper Plant In Salt Water

Some Typical Sea Plant Growths

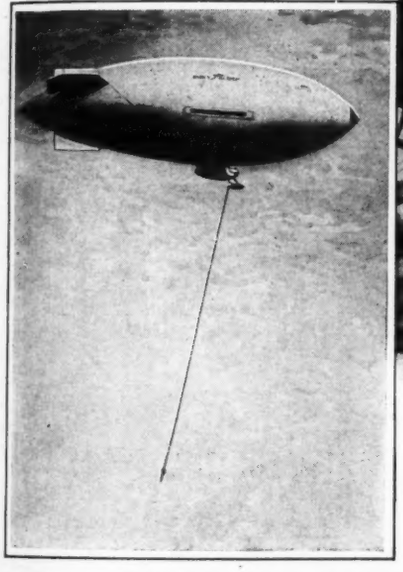
Sulphate of Copper Plant

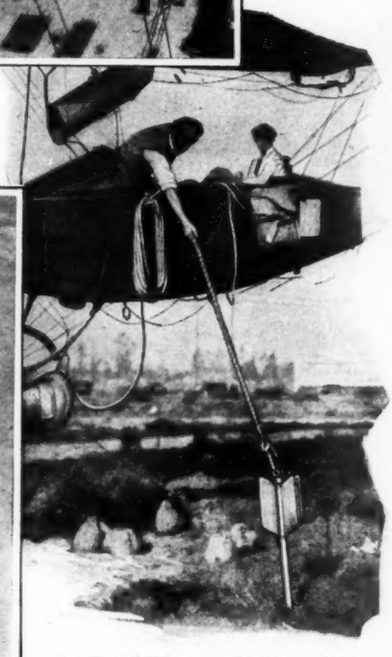
These remarkable photographs show the similarity of the chemically produced artificial plants to the natural ones. The four at the top of the page show lecithin, from egg yolks, growing. The first three are magnified 50 times and the fourth, 150 times

Flyers Turn to New Ideas

Gigantic duralumin frame of the new Zeppelin *LZ-127*, being completed in Germany by Hugo Eckener, builder of the American dirigible *Los Angeles*

The first hydro-glider, equipped with air-filled pontoons, successful in a recent test in Berlin, is drawn by a motor boat, as shown in the photograph, until it attains sufficient momentum to rise. The inventor, Hans Richter, who directed the trial of the odd craft, declared it more than met expectations



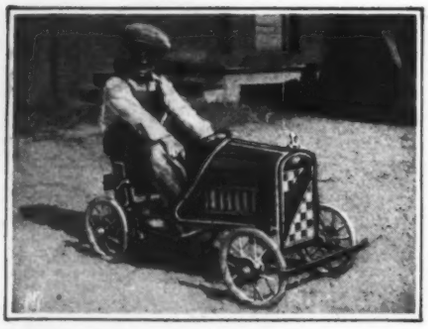


Small dirigibles may land anywhere at will, it is said, with this anchor, invented by George Hockensmith. Dropped from 100 feet, it digs its barbs fast in the dirt and the flyers pull down the ship

Taking-off in ten seconds is easy with this strange caterpillar landing gear, according to reports of recent tests in France. Danger of fouling the wheels, a common mishap, is said to be eliminated. The cleated belts move around the landing arms at the slightest movement of the ship. M. Chevreau, the device's inventor, is seen at the extreme right

The first floating dock for giant flying boats is shown here receiving the Dornier Superwal (superwhale) in Germany. With a supporting capacity of 100 tons, it can also receive airplanes and launch them by catapult

The largest "aerial signpost" in a city, atop a Denver building, is a 110-foot arrow, directing flyers to Lowry Field. It is visible from a height of 5000 feet. The plan is recommended to all owners of large buildings



Toy Car Claims Speed Mark

FASTEST of toy automobiles, says the maker, is a new lightweight car for the children. Among its novel features are a safety system of double brakes and a patented bicyclelike sprocket that enables the youthful driver to go forward, reverse, brake and coast at will. Steered by the conventional wheel, it is propelled by a chain drive similar to that of a standard racing automobile. The car is of all-steel construction, hence durability is claimed as one of its virtues.

Baboons as Servants Advised

IF YOU need a faithful, efficient house servant, not subject to human failings, try a baboon. That is the startling advice of Prof. F. A. Lindemann, of Oxford University, England. In twenty years, he declares, there need be no servant problem. This is the time it would take, he says, to breed apes intelligent enough for simple household duties—dusting and sweeping, for instance.

Steam Well Power Unlimited

GREAT, undeveloped power resources —the smoldering fires within the earth—have just come in for attention with a recent survey of the California natural steam wells. Two experts of the Carnegie Institution, Dr. E. T. Allen and Dr. Arthur L. Day, have reported the results of the first thorough investigation of its kind in America. Despite eight borings in the local area where natural steam is abundant, a little valley near San Francisco, the tapping has caused no apparent reduction, they find, in the available pressure of from sixty to 275 pounds. There seems no reason why further enterprises should not be conducted on a larger scale, as has been done at Larderello, Italy, to furnish commercial power.

The Italian natural steam, they point out, contains corrosive substances and must undergo a costly purification before it can be used in machines; but the California steam is pure enough to use directly as it comes from the ground.

Seaplane Can Go 4000 Miles

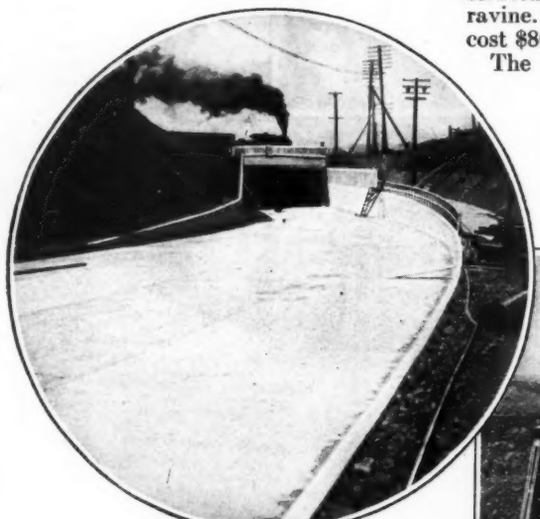
EVERYTHING new in aeronautical science is said to be incorporated in the Navy's latest seaplane—a giant with a cruising radius of 3000 to 4000 miles that could conquer the Pacific! The first of these "PN-11" planes, secretly built at Philadelphia, has just been completed, and twenty-five more are to follow.

Secretary of the Navy Wilbur, denying reports that the plane will be used in a Pacific or globe-girdling flight, states that it will be placed in regular service. It is designed to carry about 1300 gallons of gasoline, more than Commander Byrd's huge plane bore on its flight across the Atlantic to France.

New Way to Tell Time in Bed

TO TELL the time, without turning in bed, an English inventor had devised an apparatus that projects to the ceiling a magnified, illuminated image of his watch-face! He slips his watch into the device before retiring; a touch of an electric switch conveniently located on his bed at any time during the night and the hour is indicated above him.

Within the box-shaped apparatus are an electric bulb, a mirror, and a lens to accomplish his end. It is the reflected, magnified image of the watch or clock face that the sleeper sees. The annoyance of a noisy timepiece is obviated, as it can be placed far enough from the bed to make its ticking inaudible.



A $275,000 Floating Road

ENGINEERS recently laid a unique floating roadway when they constructed a $275,000 underpass to avoid a grade crossing at South San Francisco. To pass beneath twelve main-line railroad tracks, the road dips three feet below sea level. It rests upon a mud and water foundation alone; six hundred steel anchors hold it in place.

New Chemical "Ice" for Rink

NO MATTER how hot it is, you can skate and coast as in midwinter on a new kind of "ice" devised by German chemists, now installed in a Breslau exhibition hall and skating rink. Although, it is said, you can slip and fall on it as effectively as on the natural substance, the new compound does not melt even at a heat of 208 degrees!

Resembling the frost that collects on ammonia refrigeration pipes, the artificial product is poured on wood and hardens quickly. Its manufacture is by a secret process, although it is known to be purely chemical; no machinery whatever is needed in order to make it.

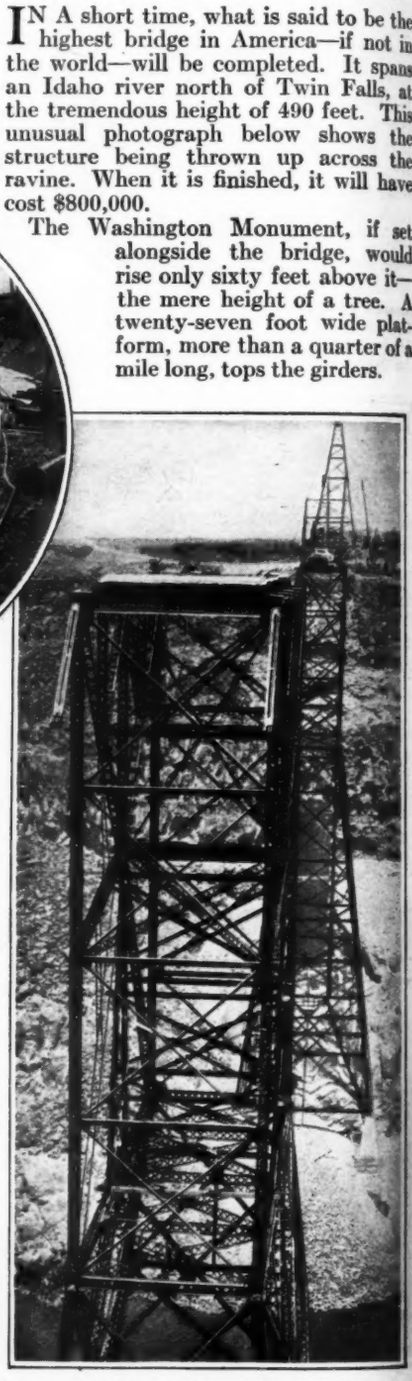
Planes Use Costliest Wood At $600 for Thousand Feet

PROBABLY the highest-priced lumber that comes from a log, lumbermen say, is the hand-picked Sitka spruce used in the building of airplanes. Not every log will supply the quality demanded—a clear straight-grained spruce of the highest standard. Only a half dozen mills in the Pacific Northwest can supply the rare wood, and it takes from three to six weeks to assemble a carload. The average airplane requires for its manufacture nearly a thousand feet of the spruce, at $600 a thousand, for its wing beams, struts and other parts.

Bridge Nearly 500 Feet High

IN A short time, what is said to be the highest bridge in America—if not in the world—will be completed. It spans an Idaho river north of Twin Falls, at the tremendous height of 490 feet. This unusual photograph below shows the structure being thrown up across the ravine. When it is finished, it will have cost $800,000.

The Washington Monument, if set alongside the bridge, would rise only sixty feet above it—the mere height of a tree. A twenty-seven foot wide platform, more than a quarter of a mile long, tops the girders.



An unusual close-up photograph of what is called America's highest bridge, in Idaho. The 550-foot Washington Monument would top it by only 60 feet

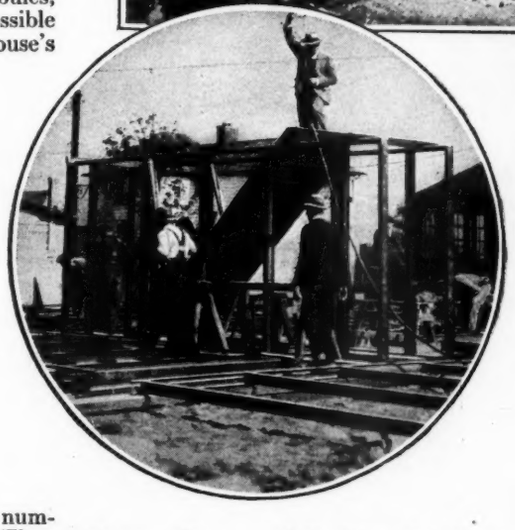
Steel House Erected in Little Over Three Hours

WHAT is said to be a speed record in home construction was achieved recently at Forest Hills, N. Y., where architects and engineers saw workmen erect the steel framework of a two-story dwelling in three hours and twenty minutes! It was a demonstration of a new system of house building by the use of standardized steel members similar to those used in constructing skyscrapers.

When Robert Tappan, architect and engineer who designed the steel house, mounted its skeletonlike beginnings and gave the starting signal, the fabricated frame began rising.

By going a step farther and turning out factory-made porches, vestibules, chimneys and bay windows, it is possible to construct seventy percent of a house's parts in an industrial plant, Tappan says. He plans to erect houses of this type throughout the country. Through the economy of standardization, he declares, they will cost less than wooden houses do today.

Steel framework makes the house practically indestructible, it is said, and the dwelling cannot warp or shrink.



A workman waves a flag to signify completion of the assembling of the factory-made steel frame of a dwelling at Forest Hills, N. Y., in three hours and twenty minutes. At the left Robert Tappan, architect and engineer, who originated the idea and plans to build such houses throughout the country, gives signal to start the main construction

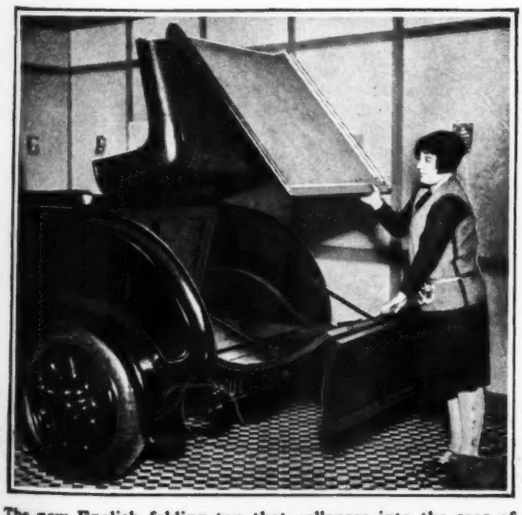
Foolproof Elevator

YOU can't be carried past your floor in the latest type of automatic elevator, recently introduced in New York and other American cities. On the ground floor the operator presses a numbered button for every stop desired. Then he starts the elevator; without further control, it shoots upward and stops at the first floor called for. The doors fly open automatically; a touch of a lever closes them and the elevator continues until it stops at the next level desired.

So perfect is the mechanical control that the elevator always stops with its bottom edge flush with the floor. On its down trip, the elevator again stops automatically at every floor where a waiting passenger has pressed the "down" button on the wall of the corridor.

Open Car and Sedan in One

WHEN the weather is on its bad behavior, the open car loses much of its attractiveness. It's a quick change to a closed one with a remarkable new convertible type of automobile recently exhibited at Westminster, England. From the rear compartment, as seen below, unfolds a substantial top that is quickly set in place and made weather-tight. In fair weather the covering is completely hidden and the car's lines are unmarred by the presence of a folded top. Even with the cover folded away, there is said to be ample space in the rear compartment for luggage, tools, and spare automobile parts.



The new English folding top that collapses into the rear of the motor car when not in use and in bad weather converts the machine into a sedan. When out of service it cannot be seen

Any Questions?

THIS magazine is always glad to answer inquiries of readers concerning all subjects within its scope and to furnish names and addresses, whenever possible, of the makers of articles described in its pages. Replies are made as promptly as possible in view of the time required for research, and every effort is made for absolute accuracy. Inquiries should be accompanied by stamped self-addressed envelopes and directed to Information Department, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City.

Star a Pulsating Gas Bubble

"A GLOWING, gigantic bubble of gas that shrinks and swells" is the astronomer's latest description of Mira, a remarkable star that graces the celestial equator. Recent observations with the aid of a light-recording instrument, devised by Prof. A. A. Michelson, attached to the great 100-inch telescope at Mount Wilson Observatory, prove that as the star becomes periodically bright and dim, a phenomenon of which astronomers have been aware for centuries, it actually waxes and wanes in size. Astronomers believe the amazing power that blows the gases composing the star outward and sucks them in at intervals of eleven months comes by extraction of energy from the atoms of matter.

Betelgeuse dims and brightens for a different reason, says Dr. Joel Stebbins, University of Wisconsin astronomer. A red star, such as this one, he proposes, probably has "star spots" that, rotating, periodically obscure part of its face.

Magnifying Your Strength

BY THE lightest touch of your hands, through a marvelous new mechanical device, you have power enough to steer a ship or aim a huge gun. These are the latest uses seen for the "torque amplifier," developed under direction of H. W. Nieman at the Bethlehem Steel Works and described in the January POPULAR SCIENCE MONTHLY.

When you turn the "control shaft," the "work shaft" turns in the same direction and its power is ten to fifty thousand times greater than yours!

Bright Children Not "Queer"

UNUSUALLY bright children are neither queer nor likely to become so later. That is the opinion of a number of authorities. Clever children, they agree, generally come of distinguished parents, have unusually good health, are fond of play, are popular with other children and show no peculiarities.

Odd Utilities *and*

Ferris Wheel Preserves Phone Girls—Bundles Pocket Tray for Other Strange

Phonograph Relieves Phone Girls

"The number is changed; please consult new directory," a mechanical voice now tells phone users in Paris. When a changed number is called the operators save labor and avoid delaying other calls by plugging in on the ever-running device

A Vest Pocket Ash Tray

Cigarette rest, ash receiver and extinguisher are combined in an unusual case that saves embarrassment when you are deep in a divan and your ashes threaten your hostess' rug. The air-tight cover extinguishes the stub

What a Harmonica Grows Up to Be

A tuba, one would call this instrument at first glance, but, believe it or not, it is a harmonica. Risen from the lowly level of the mouth organ, this carries the name of symphonic chromatic bass harmonica horn. Soloists in orechestras play on it

Ending Nuisance of Wet Umbrella

Damage to floors and to clothing is avoided by the umbrella holder illustrated above for churches and halls, invented by Ambrose O'Rourke, of New York City. The holder is attached to the end of a pew or row of seats, as shown at the extreme left; a tube fitted into the bottom drains the water through a hole in the floor into a pail or other receptacle that is conveniently hung. Losing umbrellas in coat rooms is also ended by the novel device

Eggs Kept Fresh by Daily Ride on Tiny Ferris Wheel

Altering of their position retards the natural ageing of eggs, according to Australian Government food experts, who entered this device in a recent food and cookery show in London. The apparatus can carry a total of 400 eggs

Novel Golf Scorer in Watch Case

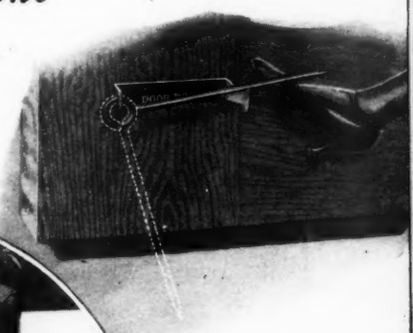
Disputes are avoided by this device whose stem you press at every golf stroke. It totals each hole around the dial, adding them all up in the center

Useful Oddities

Eggs—Phonograph Assists Wrapped by Machine—Cigarette Ashes—New Inventions

A Slot Machine Soda Fountain

A nickel in the slot gets you your favorite soda in an establishment recently opened in New York's Great White Way district. The coin makes the machine set an individual cup under the spigot and start the flow. Open the door; there's your drink all mixed

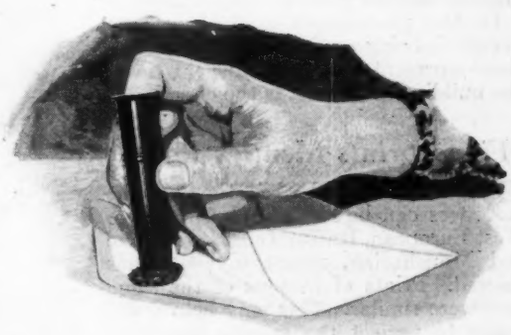


Garage Door Dogs

An ingeniously simple but positive device to hold garage doors open is a pointed spike fastened on a tiny metal rack. When dropped it sticks into the ground; when not in use it rests on a holder. A touch of the foot operates it

New Light's Colored Rays Fight White Fog

W. E. C. Stone, of Los Angeles, has developed for use of aviators a lamp whose varicolored beams contrast sharply with menacing vapor, making landing safer. A blending of selected metals in the reflector breaks natural-colored electric light into its constituent colors, sending them broadcast over a wide area

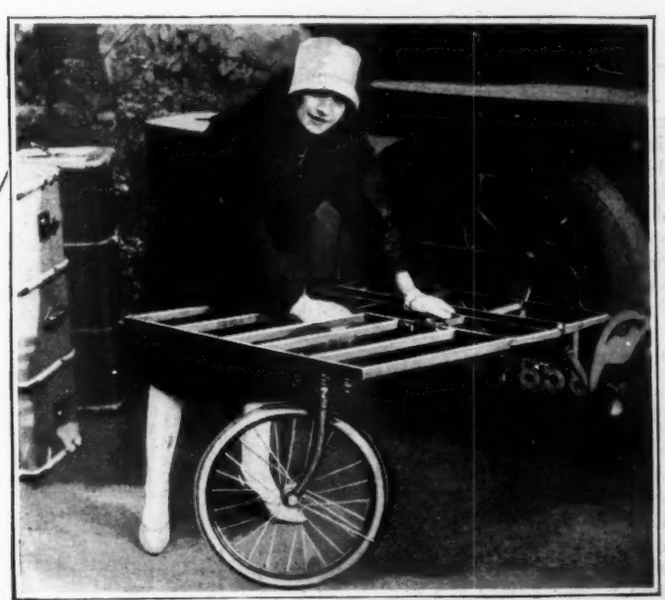


Odd Envelope Licker

Those who don't relish glue will welcome the peculiar, thimble-like device, seen at the right, for moistening envelopes. At pressure of the fingers its spongy rubber end draws water from the small reservoir in the tube and then returns what is not needed for the envelope. The handle can be unscrewed very easily when refilling becomes necessary

Bundle Tying Device

A new wonder of modern machinery is the package tyer below. Turn the crank and the twine is wound round the bundle, drawn tight, tied and cut



Novel One-Wheel Luggage Carrier for Motor Cars

Less cumbersome than two-wheel trailers, and holding four times the baggage that ordinarily can be carried, this device, recently introduced in England, may be folded up when not in use. It is devised to fit any standard type of car

Old Maps Make Lamp Shades

QUAINT old maps, some of them used by generals in planning campaigns, are now turned to a far different use by women who have them cleaned, varnished, and built into lamp shades. Many make attractive pictures when framed.

In the photograph a final coat of varnish is being applied. The squared sections represent part of an ancient town; the building at the left is the church.

Fingerprints Identify Races

BY FINGERPRINTS the world's races can be roughly classified into West European, Italian, Indian, Japanese and Manchurian, recent investigations showed. Prints of persons of the same race were similar. This may help eventually to perfect the specific classification and subdivision of races.

Unique playing cards made of tiles, which remind one of Mah Jong and dominoes, add novelty to a bridge party and permit play on the porch or in the garden on a fair but windy day. They last forever

Playing Cards in Tile Form Defy Wind and Hard Usage

A NEW deck of cards in tile form, which borrows the traits of Mah Jong, lets the hostess give her bridge party on the porch without fear of a sudden breeze disturbing the cards. Their solid construction prevents the wear that brings worn corners and cracked backs to paper cards.

The "cards" are packed in an attractive box which, as seen below, also provides individual racks for holding the "hands." The tiles are not dealt, but each player picks his own, as in dominoes.

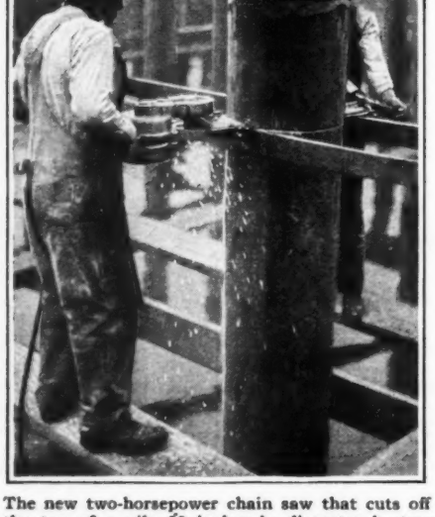
Clock Times Life of Truck

HOW long can a truck run before it wears out? So owners may determine, and thus know the actual cost of trucks in their business, a new clocklike instrument has been invented. Attached to any moving part, it starts to register when motion commences and stops when the machine is idle. Its dial tells just how many hours up to ten thousand, that a truck, or for that matter any machine, has been run, regardless of the speed at which it operates.

The period of active use often sets the real life of a machine, instead of the days or months of off-and-on use. A huge cannon, for instance, must be rebuilt after an active life of about three seconds, the time required to fire 150 to 200 shells.

Novel Saw Cuts 24 Piles in 50 Minutes

TWO minutes and "she's through"—with a new electrically driven chain saw that has been applied to pile cutting. Such was the time "clocked" for this heavy twenty-inch piling, and but fifty minutes was required to cut a row of twenty-four. Weighing only seventy pounds, this device, which promises great saving in dock work, is easily portable. A two-horsepower motor drives the saw.



The new two-horsepower chain saw that cuts off the top of a pile 20 inches in diameter in two minutes. It is portable, weighing only 70 pounds

Sky Plays with Sound Waves

FAR up in the air amazing things happen to sound waves. Dr. F. J. W. Whipple, of the Kew Observatory, England, found not long ago that sometimes he could hear a cannon sixty miles away eleven minutes after it had been fired; normally the sound would take less than half this time to cover the distance. At some nearer points the explosions were inaudible. Whipple suggests that sound waves are sometimes reflected back to earth from a warm atmospheric layer twenty-five miles or more above.

Know Your Car

A VARIETY of accidents can happen to your automobile that will cause trouble and expense, but there are forms of carelessness for which you may have to pay with your life.

Driving with weak or defective brakes is one of them. Failure to inspect the running gear and steering mechanism at regular intervals is another. You can't plead ignorance so far as poor brakes are concerned, because you can't drive any distance without knowing just how your brakes are working. So if you get into trouble with brakes, blame yourself.

That doesn't apply to trouble in the running gear and steering mechanism. Everything may work fine until some day, when you are speeding along a nice road, a loose bolt drops out and you are dumped into a ditch or plastered against a telegraph pole. Go over every bolt and nut in the running gear and steering mechanism regularly!

New Paint Striping Device Lets Anyone Decorate Auto

A NEW tool makes long practice unnecessary for automobile paint striping jobs. With one of these instruments, illustrated below, any striped design work may be duplicated by an inexperienced painter.

The compasslike device has two interchangeable barrels for fine and medium lines attached to one arm and fed by a rubber lacquer-container. The other arm is used for a guide along a molding or rule and stripes are spaced as desired by adjusting the thumb screw. Curved, straight, or design lines may be made.

Longer life of the stripes is claimed by the maker because a slightly thicker coat of lacquer is said to be applied than in the case of work done by hand.

The machine for painting stripes on motor cars (left) is in the form of a compass. One arm serves as guide; the other carries interchangeable fine and medium barrels from which lacquer is fed in even lines

Toad Challenges Camera's Speed

OFFICIALS of the London Zoo recently obtained the first movies of a Spanish toad swallowing his meal of a worm. A camera taking 1500 pictures a second was required! One taking 500 a second had completely missed the eating act.

When the authorities carried off their first film and developed it, they found they had good pictures of the toad, but between two of them the worm simply disappeared and how he went remained as much a mystery as ever. When they succeeded with the faster camera the film showed the toad's tongue hitting the worm much as a batter strikes a ball, and whisking it out of sight into his mouth. It was all over in less than a sixtieth of a second.

How Much Do You Know of the World You Live In?

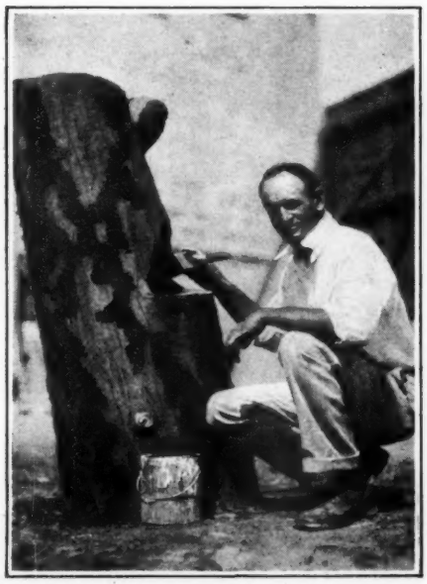
THESE questions are selected from hundreds sent in by readers. Test your knowledge with them. Correct answers are on page 166.

1. What is the northernmost town in the world?
2. What country is especially famous for its butter?
3. Where is fresh water found 200 miles at sea?
4. Where do men have their wives whipped by law?
5. Where does the abalone live?
6. What Alaska city is as warm as Philadelphia?
7. Where do goldfish come from?
8. What is a "dry lake"?
9. Where is there a lake of crystal soda?
10. What are the Antipodes?
11. Where are prayers burned instead of being said?
12. What became of the Temple of Solomon?

Tree Stump an Incinerator

THE question of what to do with old tree stumps has been almost as baffling as the time honored "What shall we do with our old razor blades?"

H. W. Ayers, of Burbank, Calif., made an incinerator out of one in his back yard, which was so successful that neighbors were not slow in copying it. Ayers says he got the idea from a dream. The picture below shows him giving his novel and useful contrivance the finishing touches.



The refuse incinerator made from an old tree stump in his back yard, to which H. W. Ayers, of Burbank, Calif., is here seen applying the finishing touches

A Mechanical Professor

AND now we have the mechanical tutor—a portable professor, to be exact! It is a device that will teach you foreign languages, card games, and the like. If you would learn bridge, for example, all you do is place the arm with the squared indicator over the line of pictures illustrating that game and turn on the power. A phonograph attachment explains the points of the game as each picture comes to view. A synchronizing device makes this possible.

A. L. Runyon, a mechanical engineer of Los Angeles, invented the machine.

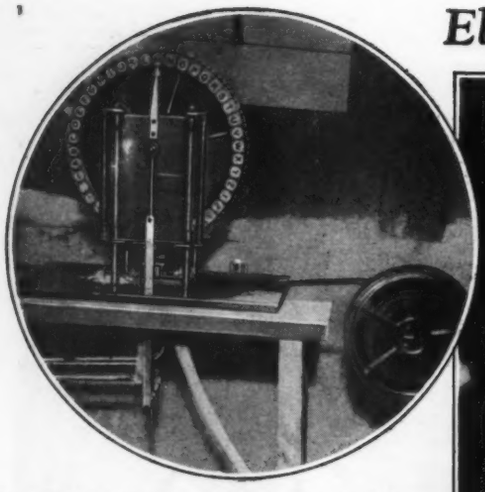
Cheap Cornstalk Walls Now

WALLBOARD made from cornstalks, a long-standing laboratory achievement, is now about to become a commercial process, thanks to six months' research by specialists of the U. S. Bureau of Standards. At present the huge corn crop is called the outstanding example of farm waste in the United States—less than twenty percent is used as food.

Last year Congress appropriated $50,000 for the Bureau of Standards to use in seeking to eliminate waste, as described in the May, 1927, POPULAR SCIENCE MONTHLY, by putting cornstalks, peanut shells, cotton burrs and cotton seed hulls to use. Now, after experiments, a plant for the manufacture of wallboard from cornstalks has been set up in coöperation with the Iowa State College, according to Dr. W. E. Emley, director of the research.

The experts have simplified the problem of extracting from peanut shells nonedible sugars valuable to the soft drink and tanning industries. These, it is expected, will soon be available to industry. Furfural, widely used to make synthetic resins, is promised by cottonseed hulls. The tons of cotton burrs left unused by cotton gins still await a profitable use; though Dr. Emley says that all these wastes furnish a cellulose, from which artificial silk can be made.

Electric Signs Flash Paris News Bulletins



The machine that cuts stencil letters on the strip of heavy paper, spelling out the news bulletins to be flashed from tops of newspaper offices in Paris

Light bulbs turned on and off by a stenciled band passing behind them flash the letters of the stencils, giving Parisian crowds the latest news. The bulletin seen refers to the American Congress

AN INGENIOUS news-flashing system has been used of late by Paris newspapers to inform the boulevard crowds of the day's latest developments. The device resembles the running advertising phrases and time signals flashed in some of our larger American cities, but offers up-to-the-minute news which the operator receives by telephone and spells out on a lettered machine. This in turn stencils a heavy paper band that is run over the back of a frame carrying a bank of electric lights. Each bulb in the frame has a wire which causes it to light when touched by the stenciled letters, and thus spell out the sentences to those below.

Sugar Produced by Chemistry

FOR years laboratory experimenters have sought in vain to duplicate the secret processes by which living plants form starch and sugar from sunlight, carbon dioxide gas absorbed from the atmosphere, and water taken in through their roots. At last, by an ingenious method, Prof. E. C. C. Baly, of Liverpool University, has succeeded.

To water and carbon dioxide in a glass tube he added colored catalysts in the form of salts—carbonate of nickel and cobalt. When the mixture was exposed to visible light from an electric lamp it produced substances that passed all the chemical tests for sugar!

Professor Baly found also that growing plants may need the polarized light from the moon to convert into sugar the starch stored up in the leaves by direct light from the sun.

Heart No Pump, Says Doctor

THE accepted idea of the heart as an automatic pump sending blood to all parts of the body may have to be revised.

A famous German heart specialist, Dr. Mendelsohn, says the heart is simply a governor to control the orderly flow of the blood, this current itself being due to the constant intake and outgo of liquid caused by chemical action in the body cells.

Dr. Mendelsohn says the heart, a small muscle the size of a man's fist, "could not possibly be capable of driving the tenacious mass of the blood through the entire body." He cites invalids with hearts so flabby as to release scarcely any energy, yet they lived for years with sufficient blood circulation.

The heart, he says, takes constant care that the blood flow be orderly.

Engineers' World News Service

WHAT engineers are doing the world over is made available in a moment by a remarkable new service of the American Society of Mechanical Engineers. Libraries and other subscribers receive each week a batch of index cards to be filed in a special cabinet, bearing titles and abstracts of articles on engineering problems that have just appeared in American and foreign technical papers.

For those who have restricted interests, cards bearing only information on their subjects are supplied. More than a thousand publications of thirty-seven countries are digested for the subscribers.

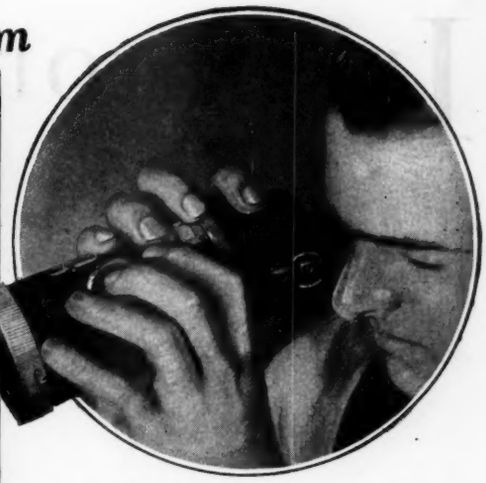
Monorail Cars under River

MONORAIL cars will scud at sixty miles an hour beneath the River Tyne on a new type of underground railway seen below, designed by E. W. Kearney, British engineer, if his plan, already passed by the Ministry of Transport, is approved by Parliament. First of its kind, the tube is to connect North and South Shields. Along the middle of its floor will run the single rail that supports the weight of the novel subway cars; a guide rail above keeps them from toppling and completes the electric circuit by which they receive power.

By eliminating swaying and jolting, the track design permits high speed, the inventor says. Stations will be elevated above the tube level, giving cars a "running start" downgrade and automatically slowing them at the other end. This is said to result in a great saving in power, and reduction of jolts and wear.

E. W. Kearney, British engineer, exhibits model of the monorail cars with another rail above to steady them and supply electrical power, which he expects to run in a tunnel beneath the River Tyne

Cement Mine a 40-Acre Mushroom Farm



Farming by torchlight under the ground is the business of Howard Bell, who is seen here with a gasoline flare, tending some of his forty acres of mushroom beds. This unique large scale gardening operation goes on in an abandoned cement mine, where the temperature is ideal for mushrooms

ONE of the strangest farms in the world is the great subterranean acreage of Howard Bell, of Crittenden, N. Y., on which he raises huge crops of mushrooms. Seeking means to cultivate the delicacy, which thrives without daylight, on a wholesale scale, Bell conceived the idea of using an abandoned cement mine. The results were even better than he anticipated.

Throughout the entire underground agricultural plant a temperature of from forty-seven to fifty-one degrees is maintained the year round, this being ideal for the product.

Little light is used in the operation of the unique farm of forty acres. Bell tends his plants with the aid of gasoline or other artificial illumination. None of the mushrooms in his beds ever sees sun.

Thousands of persons grow mushrooms in cellars for their own use or for market. Bell has many thousands of cellars in one.

"Coldest Spot" Is 452 Below

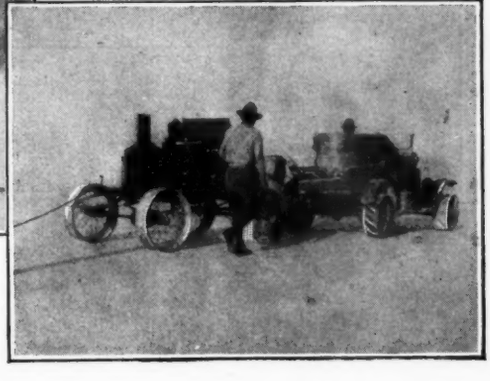
THE coldest spot on earth is a new laboratory in Berlin, to study strange changes that take place in substances exposed to temperatures as low as 452 degrees below zero—within about eight points of absolute zero! This is done by liquefying helium gas under high pressure, then allowing it to expand.

At such a temperature some metals, such as silver and copper for example, lose their resistance to electricity, becoming super-conductors. A thread of frozen mercury, it is said, can carry enough electricity for several hundred lamps.

Phone Insulators' Bath Day

TELEPHONE line insulators in the Salt Lake Desert, Utah, have a regular wash day to remove salt blown from near-by beds, which cakes on the glass and causes leakage of electricity.

Steam is sprayed over the insulators from a nozzle on the end of a fish pole. Though an ageing action on the glass results, B. F. Howard, engineer of the telephone company, says the economy of the method he has developed justifies it.



Washing the caked salt off telephone insulators with a steam nozzle on the end of a fish pole on the Salt Lake Desert. At right: the mobile plant that supplies steam of eighty to ninety pounds pressure, oil being used in heating of the efficient boiler

Optical Device Gages Heat

EVEN the blistering heat of molten metal pouring from a furnace can be measured conveniently and accurately by a new instrument resembling a small telescope. When it is pointed at the glowing stream, the brightness of the reflection seen through the eyepiece is taken to indicate the temperature. Through an adjustable dial this glow is compared with that of a small electric flashlight bulb within the device, and the exact number of degrees directly indicated when the two are matched through a red sighting glass.

This simplified optical pyrometer, as the device is called, will measure accurately the temperature of a glowing body only a quarter-inch in size ten feet away! Unlike types that record electrically the heat of a fire, as sighted through a furnace door, this instrument can test the temperature of pouring metal and of small bodies not inclosed.

Why Boys Eat So Much

IF YOUR son puts away a bigger meal than you yourself can eat, don't be surprised, advises the Bureau of Home Economics of the U. S. Department of Agriculture. He is merely behaving like any normal, active boy of nine to eighteen. At certain ages boys and girls may need one to one and a half times as much protein and mineral matter as adults, according to a new dietary scale worked out by the Bureau that gives the needs of each member of the family.

Do Radio Waves Never Die?

THAT the voices of famous present day men, transformed into radio waves, are now wandering around the earth and may be picked up a century hence is the startling contention of engineers of the Marconi Company, London. Such waves, they say, never die out completely; with sensitive enough receivers they might be heard in 2028! Already they have heard programs that have circled the world three times.

Commenting on the idea, Dr. Lee de Forest, inventor of the vacuum tube, said, "Theoretically the waves exist forever, as do those of the ocean. The splash made by Noah's ark is still in existence. Radio waves are too weak to be recorded by existing receivers even a few minutes after their emission."

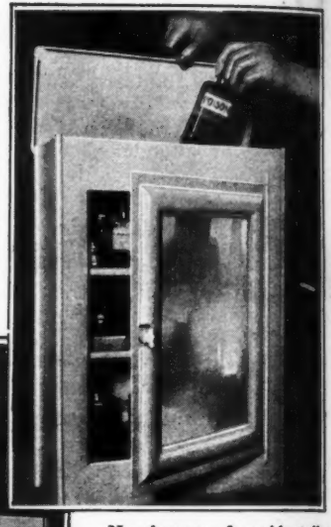
Inventors' Ideas Add to H

Putting a keen edge on the carving knife or other cutting utensil becomes easy for the housewife with a new grinding wheel which is clamped to the kitchen table. The grinder is belted from a hand wheel to give high speed with minimum effort. A guide attachment aids in holding the knife at the correct sharpening angle

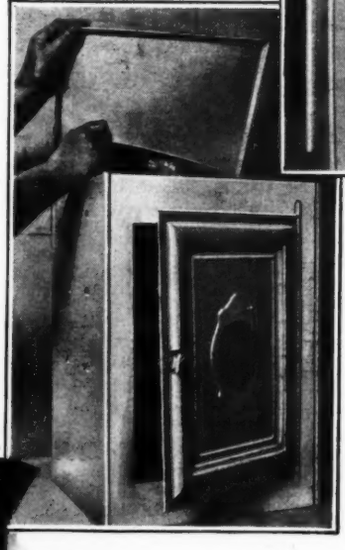
Steam heat produced by electricity and ready at the turn of a switch is the feature of a new portable heating cabinet. The little radiator need only be plugged into a wall or lamp socket. It is so light that it can be moved on casters from room to room as needed

A new idea in mechanical burglar alarms is a large gong bolted to the door knob so that when the knob is turned the gong instantly arouses the entire household. No batteries nor electrical connections are required

Here's a new, one-hand flour sifter that leaves your other hand free for mixing dough or beating batter. When you squeeze the hinged grip, an agitator whirls back and forth over the sifter's wire bottom and speeds the flour on its way. The operation is rapid and convenient

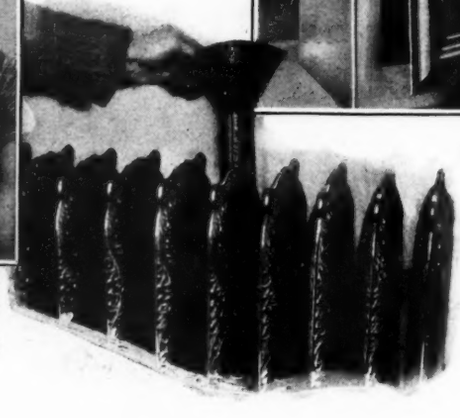


No danger of accidentally removing a bottle of poison, in the dark, in mistake for another, from a new folding medicine cabinet, pictured above. It has a separate compartment at the top for the poisonous substances



Johnnie won't know where the cookies are kept—for a while, at least—if they're placed in the secret top compartment of the bread and pastry cabinet at the left. Both of these are portable cabinets, folding to fit into a small space

A London hotel keeper, to avoid discarding worn brooms entirely, invented this clamping device by which new brushes can be attached to the old handle. It also permits a brush to be reversed and the other side used after one side has become worn thin



In filling a narrow water pan humidifier located behind the radiator it is usually difficult to keep from splashing the wall or floor. To make the task easier, this special funnel has been devised. It is of large diameter, with an unusually long neck that makes the water pan readily accessible

Home Comfort

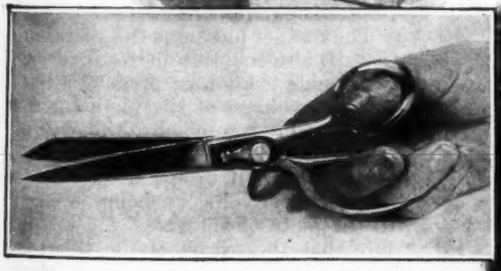
Provided with two drawers and a spacious top surface, a unique new inclosure for the ordinarily unsightly radiator serves as a useful desk or library table. Heat is radiated through a grating below the drawers, but the construction is such that magazines, books, or writing material may be placed inside without damage from the heat from the radiator

Foods are cooked from the inside out, it is said, by an amazing new electrical apparatus that can fry an egg in two seconds, or bake a potato in sixty seconds. The novel device is a high-power development of the radiant heater which is used for medical baking

When the funneled lid of this new cooker is filled with cold water, it prevents escape of liquids from food being cooked, by condensing the steam as it arises. The top part is lifted off to put in food

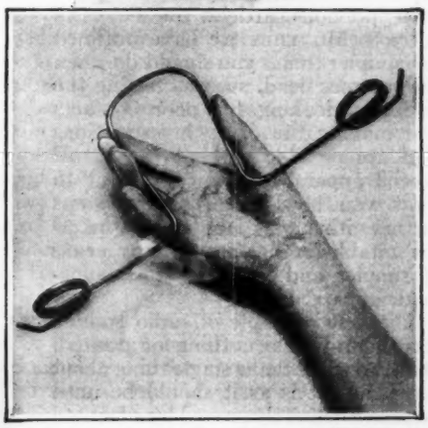
The bottle stopper attachment below not only keeps the fizz in half-filled bottles of ginger ale or charged water, but converts them into syphons. A slight pressure on the knob at the top discharges the contents of the bottle

Suspended from the wash line, as shown at the left, a new clothespin bag saves stooping for pins. The bag slides along the line, always within reach of the one hanging the clothes



The inventor of these scissors claims they need never be sharpened. An occasional right-hand turn on a small adjustment screw regulates the tension in such a way that the blades sharpen themselves. No screw driver is needed to do it

While one laundry bag is at the laundry, the other may be placed securely in this convenient holder to receive soiled clothes. The hinged frame opens to receive the container or permit its removal; no lifting is required. Throwing back the hinged lid and loosening the clasp is all that is necessary to open it



It's easy to take the sag out of old upholstered chairs and make them as good as new, it is said, by the use of a new type of spring designed to give them new life. A set of the springs can be attached beneath the old seat in a few minutes

Locating *Your* Radio Trouble

Here an Expert Tells How to Build and Use Inexpensive And Effective Apparatus to Test Your Set When It Fails

By ALEXANDER SENAUKE, E.E.

TROUBLE shooting, as practiced by the average radio fan, consists mostly of shooting in the dark.

Suppose that some evening the set goes dead. You test the batteries and find them all right. Then you look over the wires to the batteries and find nothing wrong. After that you raise the lid of the receiver and note that all the tubes are lighted. So far you have pursued the search for trouble in the approved fashion, but from there on you spend a lot of time shooting in the dark, hoping that you will be lucky enough to stumble on the trouble in time to ward off a visit from the radio service man.

You take the tubes out of the sockets and polish the ends of the prongs. You make sure that the spring contacts in the sockets are in good shape and then you begin an aimless prodding around inside the receiver with a piece of wood or the end of your fountain pen. Sometimes you find a loose wire that is the cause of all the trouble, but if you have no such luck, then what do you do? The chances are you give it up as a bad job and phone for the repairman to come up and fix the set.

BUT you don't have to give up so quickly. It's quite easy to learn how to service your own set when something goes wrong and incidentally earn a reputation among your friends as an expert radio trouble shooter.

In previous articles in POPULAR SCIENCE MONTHLY we have outlined the simpler things you should do when the set goes dead, such as testing the batteries, looking for poor contacts and making the other investigations that are possible without the aid of special apparatus. Now we want to show you how to go several steps further either with laboratory apparatus suitable for the purpose or by means of simpler and less expensive homemade apparatus.

The first principle of radio trouble shooting is to take nothing for granted. Don't consider that a single thing about the radio set is as it should be until you have definitely proved by adequate test that it really is all right. Don't assume, for instance, that the storage A-battery is charged just because the tubes light. They often glow at a temperature just below the heat that makes them effective and then you will be fooled. Nothing but a hydrometer test of each individual cell should satisfy you that nothing is wrong with the battery. And even then a poor connection in the A-battery wires may be preventing the current from getting to the tube filaments.

Similarly, don't assume that the antenna is in good condition and the ground connection firmly made, merely because they were right last week or last month. Personally inspect them to make sure.

Possession of what is known as a laboratory type test set, such as is shown in use in Fig. 2, will put you in a position to find out at once the most vital information about any radio set, and that is the condition of the tubes. It also will enable you to eliminate at once many possible sources of trouble.

In Radio Trouble Shooting—

"Take nothing for granted, prove it by testing," says Mr. Senauke, who is the assistant director of the Popular Science Institute of Standards.

"Test batteries first, then tubes, then hunt broken connections or poor contacts.

"Avoid aimless poking around; follow each circuit from one end to the other.

"One broken wire will render a set completely inoperative. One dead tube will kill reception.

"Never prod around inside the set with anything made of metal."

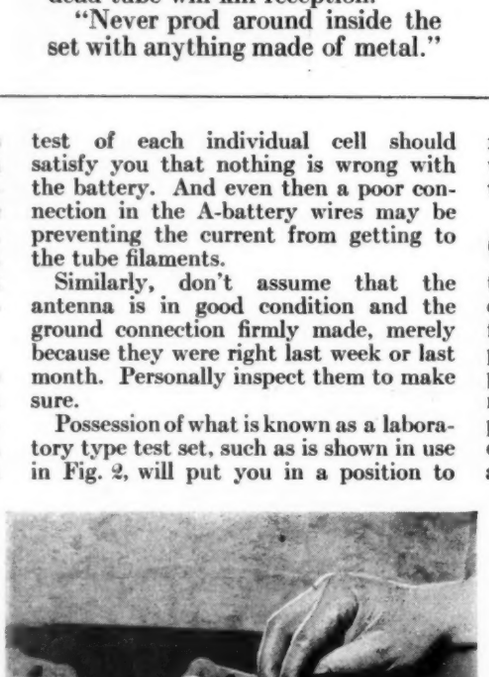


Fig. 1. This circuit tester, with a small flashlight battery inside, will instantly reveal an open circuit and will show on its dial the amount of resistance

The vacuum tubes, as you know, are the supremely vital parts of your set. All of the other parts are there merely to permit the tubes to function as they should. And the filament is the heart of the vacuum tube. When heated to the proper temperature it sends out the stream of electrons that makes the tube perform its task of amplifying the radio signals received by way of your antenna. They allow it to rectify and thus detect the signals so that they are put into a form suitable to be heard by the human ear; and without a constant flow of electrons from their filaments, vacuum tubes used as audio amplifiers could not amplify by many hundreds of times the extremely weak signals passed on from the detector tube.

OF COURSE, you can't make yourself small and crawl inside the vacuum tube in order to count the billions of electrons as they fly off from the heated filament through the grid and to the plate of the tube. But you can accomplish the same result by measuring how much current rides across between the plate and the filament on this stream of electrons. This is called the plate current and it is taken from the B-batteries or the B-eliminator, depending on how the set is equipped.

The test set measures this plate current. It also enables you to tell, merely by turning a knob or pressing a button, the voltage of the plate current as it actually is applied to the plate of the tube.

Obviously, if the meter shows that ninety volts is being applied to the plate of the tube, you can be sure that the wiring of the B-circuit for that particular tube is right clear back to the B-battery or B-eliminator.

THE test set also shows the actual filament voltage applied to the filament of the tube being tested. If you find, for instance, that the filament voltage is five, you know with absolute certainty that the storage battery is right and that the A wiring is right, and you can cross these off your list of possible sources of the trouble.

Another turn of the knob or the pressure of a different button and the

meter shows the C-voltage being applied to the tube and tells you at once that either the C-circuit is in order or that something is definitely wrong.

In other words, when you put the test plug in the socket in place of the tube and place the tube in the socket provided in the test set, you can instantly tell whether the tube is good; whether the A, B and C voltages are correct for the tube and if these circuits are working as they should. Merely by turning a knob or pressing different buttons you eliminate at once the possibility of trouble in the majority of places where troubles can occur.

By placing the test plug in each socket in the set you accomplish in a minute as much testing as could be done by the tedious testing of the individual circuits one at a time.

HOWEVER, laboratory type test sets, which cost about $75.00, are somewhat beyond the means of the average radio fan, although one should be a part of the equipment of any professional radio service man worthy of the name.

But even if you can't afford such an elaborate piece of apparatus, you can build yourself a test set for about seven or eight dollars that will be amply accurate for your purposes, even if it does not equal the precision of the special test sets.

The circuit of such a test set is shown in Fig. 3. The meter is a Weston No. 301 reading from 0 to 7 volts D.C. The fixed resistance R is 15,000 ohms. In addition to these parts you will need a double pole, double throw switch, an ordinary bell push-button, a vacuum tube socket, two binding posts and a special dummy plug that you can make out of a base from a discarded vacuum tube.

Mount the apparatus on a board or fit it to the top of a cigar box with the wiring inside. You can make it just as elaborate or as simple as you want. To construct the dummy tube plug, break out all the glass and cement in the base and solder the G and P wires to the prongs that make contact with the G and P springs in a vacuum tube socket. Fit small pin jacks or spring wire clips to the two filament prongs, which are the two thick prongs on the base of any modern X-type tube. The object of this arrangement of the filament leads from the test set is to allow you to reverse them if you run into a set in which the plus wiring is to the minus terminal of a socket.

TO USE the test set you have built, plug the dummy plug into the socket in place of the tube you wish to test, placing the tube itself in the socket you have in the test set.

Throw the switch to the left and the meter will read the filament or A-voltage actually being applied to the tube terminals. This should be very close to five volts for a 201A type tube. If it is over that figure, the rheostat is turned too far. If you can't get it up to five volts by turning the rheostat, then either the storage battery is dangerously low or there is a poor connection somewhere in the A-circuit or the A-battery wiring.

Now throw the switch to the right and the meter will tell you the amount of plate current flowing through the tube. One volt on the meter will be equivalent to 2.3 milliamperes of plate current. The plate current depends, of course, on the plate or B-voltage and on the C-voltage. If the plate voltage is ninety and the C bias is four and one half, the plate current should be two and one half milliamperes. If it is below one and a half milliamperes the tube is poor and should be rejuvenated or replaced by a new one. If the plate voltage is ninety without any C bias the plate current for a good tube should be about six milliamperes. If below four, discard or rejuvenate.

Fig. 2. Testing a radio receiver by means of a laboratory type test set. This device gives facts about condition of tubes for guidance in correcting trouble

TO determine the plate voltage, leave the switch thrown to the right and take the tube out of the socket in the test set and then press the button. The meter will now read the voltage of the plate or B-circuit as applied to it by the B-batteries or B-eliminator. Each volt division will be approximately equivalent to thirty-five volts on the plate, so that if the hand stands at slightly less than three on the scale the B-voltage is ninety, or if it points to six it is 180.

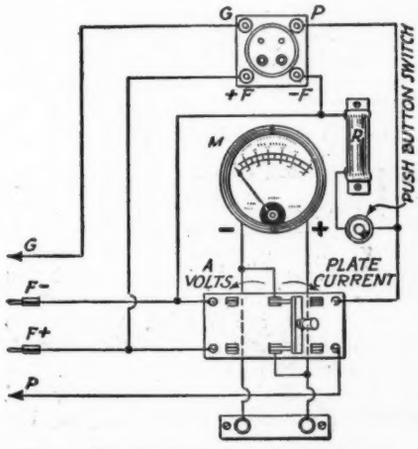


Fig. 3. The circuit of a home-built test set—not so accurate as the laboratory model of a service man, but good enough for most fans

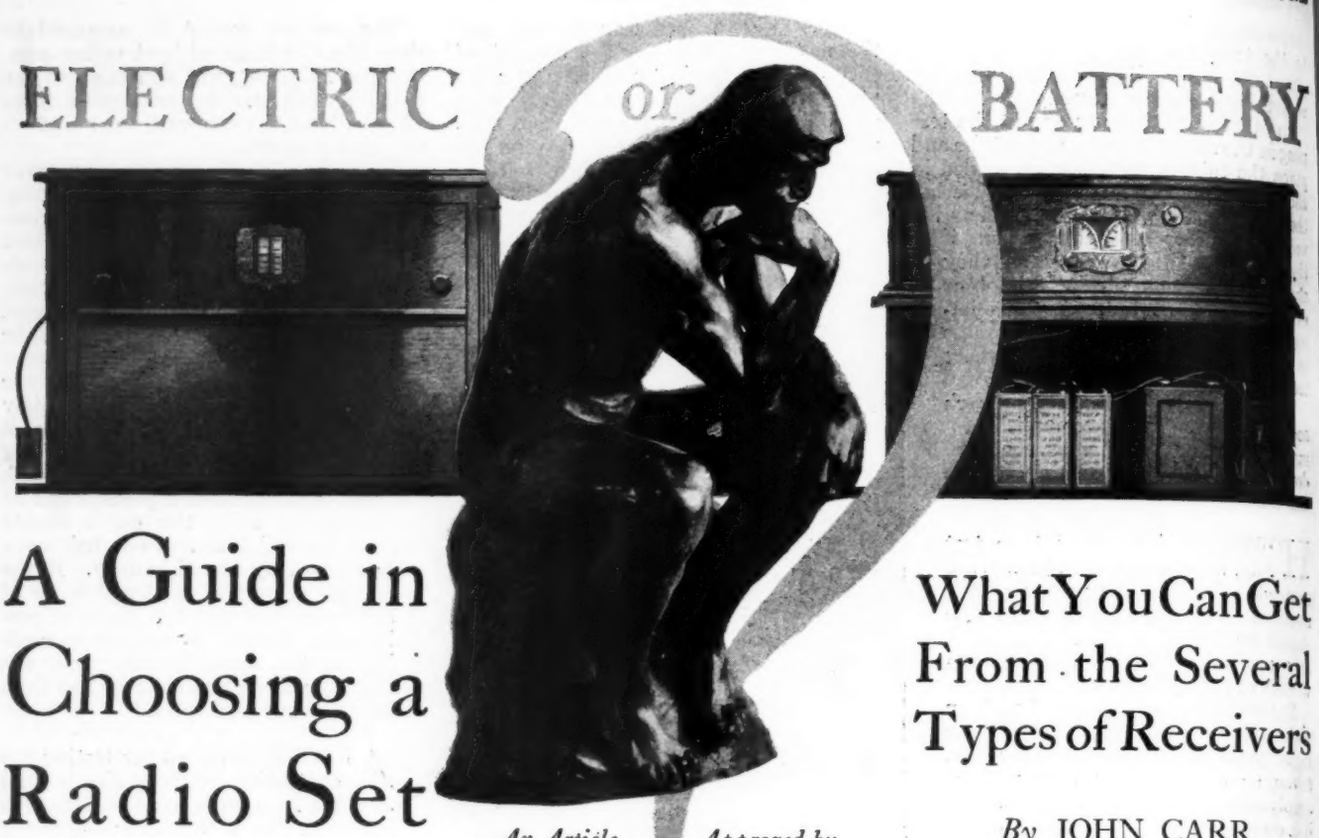
The test set cannot be arranged to show the C-voltage without rather complicated switching, but you can test the C-battery directly by connecting it to the two binding posts with the switch in the open position.

These two binding posts also serve another useful purpose. By connecting them in series with a four-and-one-half-volt C-battery and any portion of the circuit in the radio set not already proved up by the tests already outlined, you can definitely determine that the circuit is complete. If the meter does not read, the suspected circuit is open at some point. If the meter reads, you can be absolutely certain that there is a continuous metallic circuit. If the circuit being tested is just a few feet of wire with some connections and perhaps one of the tuning coils, the meter should read the full four and one half volts developed by the C-battery. If the circuit includes a fixed resistance of any value beyond a few ohms, or perhaps the primary or secondary winding of the audio transformers, the reading will be considerably less than four and one half volts.

A METER designed for testing the continuity of any circuit and showing its approximate resistance is shown in Fig. 1. Such an instrument is a valuable addition to the equipment of any man engaged in radio testing as a profession, but for home purposes the simple arrangement heretofore mentioned will suffice.

A small flashlight cell is fitted inside the meter, so that no additional batteries need be used. The dial is calibrated in degrees, and there is a table printed on the lower part of the dial so that you can determine the approximate resistance of the circuit as well as whether the circuit is continuous or not. This feature enables you to check the value of the various fixed resistances in the receiver or the power unit. In using a special meter of this type, or in testing circuits to see that they are not broken by means of the home built test set diagrammed in Fig. 3 with the aid of a four-and-one-half-volt C-battery, remember radio circuits often provide several paths between two given points. For instance, you might touch one wire of your test circuit to the filament terminal of a socket and the other to the wire running to the terminal. The meter would show a continuous circuit even if the wire did not make contact with the socket terminal. The current from the four-and-one-half-volt battery would flow between the two points by way of the tube filament in the socket being tested or through the filaments of other tubes connected in parallel with it.

WHILE most of the troubles that beset a radio receiver show up at once in poor tone quality or some other obvious form, there is one that affects neither tone quality or volume. If the C-battery supplying a power tube gives out so that the voltage drops below where it ought to be, the tube will still work well, although its life will be materially shortened. Never operate a power tube, particularly the 171 type, at lower than recommended C-voltage.



A Guide in Choosing a Radio Set

What You Can Get From the Several Types of Receivers

By JOHN CARR

An Article The Popular of Stan

Approved by Science Institute dards

WHEN is a radio receiver an electric set and when isn't it? Which is better, a battery set or an electric set? What do "socket power," "electrified," "full electric," "direct from the socket" and all the other new radio terms actually mean?

If you speak of an electric automobile you mean one operated by electricity, and, perforce, one operated by electricity from storage batteries. Logically, you would think that the term electric radio receiver would mean one operated by electricity, but as there is no such thing as a radio receiver operated by anything else, "electric" has been given a new and quite arbitrary meaning as applied to radio.

Broadly speaking, an electric radio receiver is one that operates without batteries. That's about as near as you can come to defining the term "electric" as it applies at present to radio receivers. What it may mean six months or a year from now nobody can tell, since it had no such meaning in the first place and is now being widely, loosely, and often erroneously used.

The terms "electrified," "socket power," "direct from the light socket" are merely various people's ideas of correct terms for outfits that fit in somewhere between the battery operated set and the so-called electric set.

TO CHOOSE intelligently among a battery operated set, an electric set and the combinations in between, you must know the essential differences among them.

Of course, if you have no electric light current in your home you are out of it so far as an electric set is concerned. Your problem is to choose from among the battery operated sets the one that meets your requirements. The same is true if you are in a district where the current supply service is erratic and the voltage fluctuates to a serious degree. In certain outlying districts the lights get quite dim during the early evening hours when everyone is using current and they may be extra bright late in the evening after most people have gone to bed. An electric set can be used on such a line, but the results are liable to be just as erratic as the current supply.

But if you are located where the light current service is reasonably steady you have a wide choice of equipment all designed to get the same results, that is, adequate reception of broadcasting. And if you choose good apparatus you will get the desired results equally well, whether the set is battery operated, partly electrified or full electric. There should be no difference in actual radio reception between a battery set and an electric set. They can be equally sensitive and equally selective. There is no choice for tone quality. The only difference is in the amount of attention and care required.

MAKE sure that you have alternating current of the proper voltage and frequency before you invest any money. If your current is not 110-volt sixty-cycle or if it is direct current you will need special equipment.

When you are buying your radio equipment forget all the high sounding terms and find out just what you are buying and how it operates, and read the instructions that accompany the equipment.

Note particularly what, if anything, you have to do at periodic intervals. The ideal, of course, is a set that requires absolutely no attention beyond the occasional replacing of a tube that has gone dead.

Don't let anyone fool you into believing that there is a radio receiver which operates directly on the raw 110-volt alternating current just as it comes from your light socket. Such a receiver has never been produced and probably never will be. Direct current in the B and C circuits of a radio receiver is an absolute necessity, and consequently any radio receiver that operates without batteries has a B-eliminator tucked away inside it somewhere. This B-eliminator is, to all intents and purposes, exactly like the B-eliminator you buy to use in place of dry cells on a battery operated receiver.

THE A circuit is another story. In the electric set there are three distinct methods used to accomplish the results attained by the storage battery in the ordinary battery operated receiver.

The simplest and most widely used method is to employ special so-called A C tubes that can be operated directly on raw alternating current after it has been stepped down from 110 volts to a suitable low voltage. This usually is accomplished by an extra winding on the transformer in the built-in B-eliminator.

There is no mystery about these A C tubes. The 226 and similar type tubes are exactly like the regular 201A tubes except that they have a very thick filament that has a low resistance and consequently will operate on a very low voltage, about one and one half volts. The filament heats relatively slowly and doesn't fluctuate in temperature with the rapid changes in the flow of alternating current. These tubes could just *(Continued on page 132)*

He Rebuilt His House *and* Saved $6000

How a 60-Year-Old Residence Became A Modern Home—Hints You Can Use

By

JOHN R. McMAHON

North and front side of the Penka house before (small upper photograph) and after it was made over. Half of the spacious inclosed porch is used by the tenant family occupying the first floor of the house; the other half is used by the Penkas, who make their home above

"I AM going to buy that old house on the hill and fix it up in a way you never heard of," said my friend Joe Penka about a year ago.

"Put it on wheels and take it to Florida in winter?" I hazarded.

"No, although I do have a piece of land down there. My scheme is to make it a combination of a one-family and a two-family house, so that it can be used either way on short notice."

"That sounds fairly original, but what is the object?"

"I want to live in the house myself," explained Joe, "because it is a nice location several hundred feet back from the road, fine view and everything, but it is too large for my family of four. I like company and wouldn't mind sharing the house with another family. That means adding a few rooms and putting in duplex conveniences. But suppose we change our minds about sharing, or my family increases, or somebody offers a good price for a one-family residence? With my scheme it wouldn't take more than a week to change the layout either way."

"There are difficulties," I observed. "For example, both sets of folks will want the front porch. Perhaps a movable partition is the answer."

"NO, I'LL divide that porch with an imaginary line," said Penka. "It isn't practical to divide a kitchen with an imaginary line, but you can a front porch if the people concerned are at all congenial and friendly."

"You may be right, and if it doesn't work it will be the fault of the other family," was my comment. "But how about the architectural lines of the house?"

"They're terrible now, aren't they? Look queer on every side except the front and that isn't much to boast of. There's a two-story box gummed onto the back, and beside it a little storm porch like a chicken coop—and another shed on the opposite side. The open front porch with its long spindly columns takes a lot of space and gives no service except in summer. But some of the lines are good and I rather like the pointed arch windows that you don't often see today. The rounded triangle windows for the attic are interesting and the wide overhang of the roof with the prominent cornices appeals to me. Now my idea is to replace the rear additions with a one-story structure that will match or balance with a similar glassed-in front porch. Then the house will harmonize with itself and will look well from any side."

"YOU need a good architect, and he may charge you a thousand dollars."

"I expect to be my own architect," said Joe. "I have a college diploma as a landscape architect—and the principles of landscaping and house designing are a good deal the same—proportion, harmony and contrast. And of course I learned a good while ago how to make scale drawings, which is no great trick, although many carpenter-builders shy away from them."

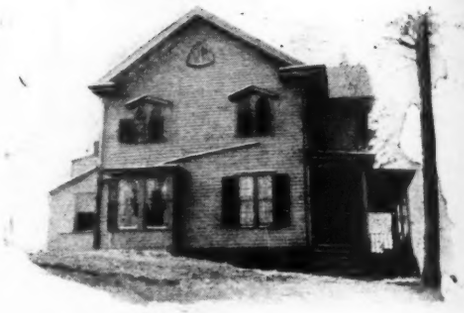
JOSEPH PENKA is one of those men who belie the proverb that a jack-of-all-trades is master of none. There is at least half a scientist in his makeup. After working in a greenhouse, he launched into market gardening on borrowed capital, originated a disease-proof lettuce, and within a few years made a modest fortune. He sold out to invest in a laundry and a public garage. Before tackling the job described in this article he had built a house and remodeled two.

To make radical changes in an old building is a proposition always followed by a question mark. All kinds of unforeseen difficulties may develop. Who knows whether the inside material is sound? In this case a careful survey convinced the owner that the job was worth while. The house was about sixty years old, which meant, in this locality at least, good materials and stanch construction. Due attention had been paid to upkeep. Oak and white pine were the choice elements of the original dwelling, nor were these timbers skimped in all dimensions according to modern style.

The entrance hall showed the proudest achievement of the old builder, a flight of stairs with a solid walnut balustrade that did not terminate at the second floor

An imaginary line divides the two-family inclosed porch of the house that Joseph Penka made over. Mr. and Mrs. Penka are on opposite sides of the line, which runs through the doorways the families share

East side of the made-over house, showing, at the left, the kitchen of the first floor tenants and at the right, their half of front porch, divided from the owner's by an imaginary line. Note improved appearance as compared with picture at right



East side of the 60-year-old house before it was made over. Note the cold, uninviting front porch and the unsightly lean-to "gummed" on to the rear

West side of the two-family home in its new guise. Its originally sturdy construction made it worth while to chuck the old front porch and the additions at the rear, and build the inclosed porch, left, and the kitchens, one of them seen at the right

West side of the old house, whose good lines were deprived of their effects by the unsightly front porch and rear additions before they were replaced with improvements that contributed to the symmetry of the whole structure

but curved gracefully around to protect the opening above. Such a balustrade is a rarity, and could not be duplicated today for less than a thousand dollars.

There were four rooms downstairs and the same number up. The alteration plan called for a division along the line of the main stairway, giving the owner all the upper rooms—of which one would become a living room and another a bath—with a part of the new first floor rear addition as an alternative sun parlor-kitchen and half of the new front porch. The other family, quartered entirely on the first floor, was to have living room, dining room, two bedrooms, kitchen and bath. All would share the front entrance, the owner having an extra side entrance to the front porch.

THE scheme required a glassed-in front porch fourteen by thirty-six feet and a rear addition of the same size for two kitchens—one regular and the other convertible to a sun parlor. Plumbing was simplified by two sinks on either side of a partition. The bathrooms were not located with the same economy, although there is a common waste pipe in the cellar.

The layout of space indicates no dining room for the owner. However, there is room for a dining alcove in the wide light main hall under the stairs, not to mention the sun parlor-kitchen.

When a builder asked $12,000 for the job, Joe decided to be his own contractor. It took him a year of more or less steady work to make all the changes, and the cost was about $6000, figuring his own labor at $3500.

"A contractor figures ten percent over estimated actual cost on new work, but he doubles the ante on an alteration job so as to allow for all unexpected troubles and costs," said Joe. "In this case he would have had no troubles and would have cleared a couple of thousand dollars."

ALL but the inside plastering and electrical wiring were done by the versatile owner. The outlay for these items with outside help was around $200 apiece.

To extend the old cellar beneath the new additions did not seem necessary, but concrete foundations to a depth below frost were made along the new lines. A cellarless construction, with double floors and building paper between, is satisfactory in mild climates at least, but good ventilation is imperative, for woodwork in a confined damp space is subject to rapid decay. In this case vents were placed in the outer foundation walls and windows were inserted in the cellar walls so that in summer air might sweep under the entire house.

The framing of the new sections—floor joists, rafters and studs—was done in fir, which compares favorably with oak for the purpose. Studs and joists were spaced according to the usual modern standard of sixteen inches between centers; rafters, twenty inches. Sheathing boards of yellow pine and then building paper were applied.

To match the old style white pine clapboards for the outside wall, spruce was used. If spruce is not the equal of white pine in exposed positions, it still ranks high in resistance to decay and if kept painted will endure as long as anything else that you might use.

MOST of the original interior trim downstairs was left in place, while fir and white pine were selected for new trim.

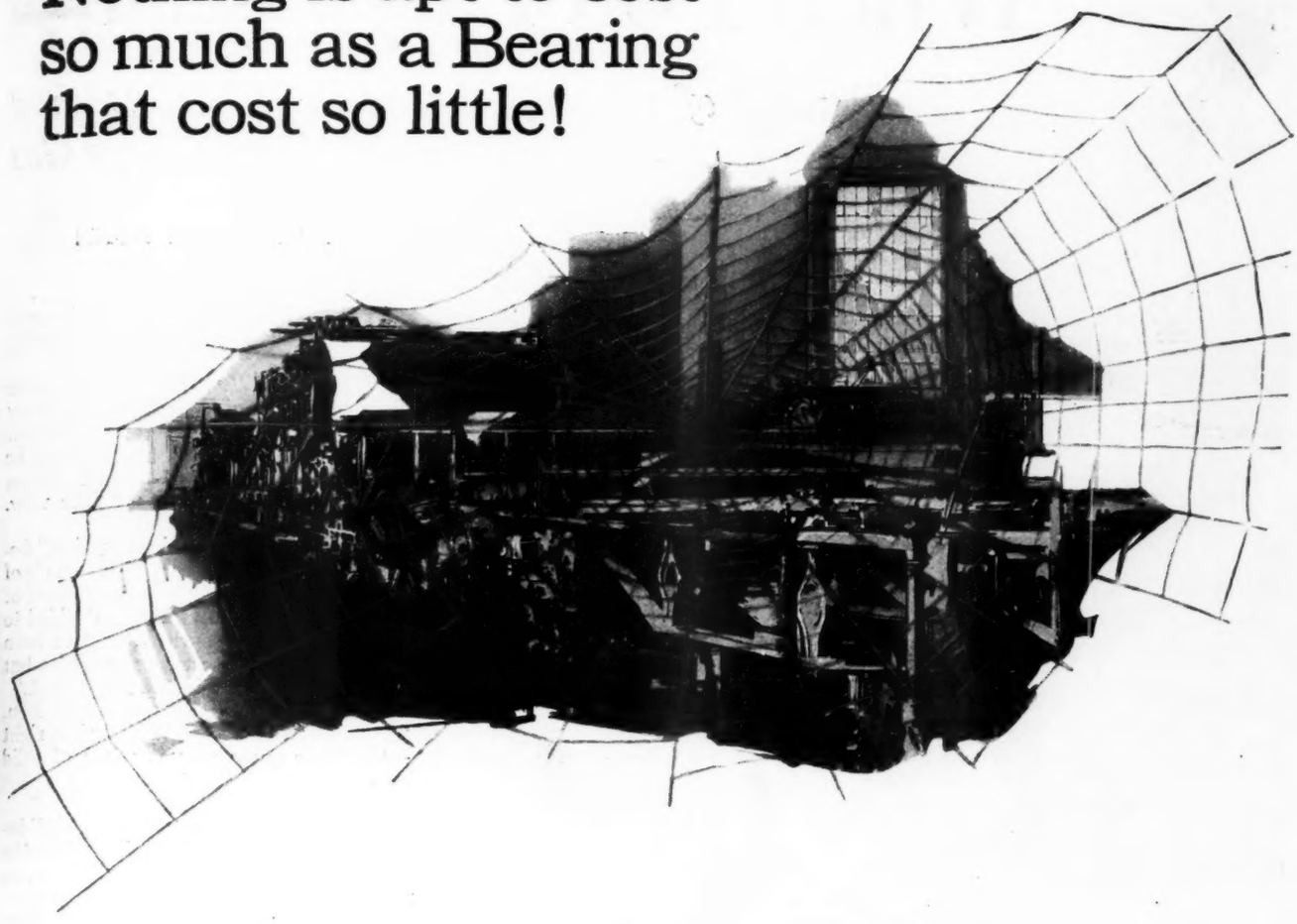
"I covered all the floors, new and old, upstairs and down, with oak," said Penka. "The old boards had shrunk, leaving cracks where dust and dirt settled. No air came through the cracks from below because the boards were tongue-and-groove, yet cold could get through. A double floor with paper between layers is warmer than a single floor. It is stiffer, does not sag or creak. Also, white pine is too soft to stand much direct wear.

"I used white oak, sawed flat grain, (*Continued on page 142*)

Your Own Building Problems

WHAT has been your experience and the experience of your friends in building and rebuilding houses? What problems confronted you and how did you meet them? What problems do you face now? Write the answers to these questions to the Home Building Department and Mr. McMahon will make your experiences the subjects of his new series of articles about real houses of real people, of which this is the first. Letters should be addressed to Home Building Department, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York

Nothing is apt to cost so much as a Bearing that cost so little!



It costs more to replace a poor Bearing than to buy the best that SKF ever produced

LET'S get right down to this matter of bearings and consider them, not on the basis of their purchase price, but on the basis of *cost* price. For *cost* price is the thing you pay.

It does not profit a man much to buy a bearing because the price is low and then actually *pay* more for lubrication, adjustments, repairs, than if he had bought the best bearing in the world.

It does not profit a man much to buy a low-priced bearing if a valuable machine goes out of service just because the bearing could not stand up.

All of which supplies the reason why you will find SKF Anti-Friction Bearings on most quality products from the small, fractional horsepower motor to the giant turret lathe or heavy duty railway passenger car.

For SKF on a bearing, like the sterling mark on silver, represents a definite standard of quality and you can depend on one just as surely as you can depend upon the other.

SKF INDUSTRIES, Inc., 40 East 34th Street, New York, N.Y.

SKF

Ball Bearings — SKF Puts the Right Bearing in the Right Place — Roller Bearings

1966

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

When You Buy a Car—

Beware of the Big Trade-in Allowance and the Service Graft, Says Gus

By MARTIN BUNN

"As a matter of fact you're both right! Each of you has picked out the car that I would have recommended"

"WHAT'S the matter with your car?" Gus Wilson asked his partner Joe Clark as the latter arrived one morning on foot.

"I could answer a lot easier if you'd ask what isn't the matter with it," Joe grumbled as he hung his hat and overcoat on the door of the tiny office in the Model Garage. "I'm afraid the time has come when I've got to dig into the old bank roll and get me a new car."

"It's about time," Gus chuckled. "I've been wondering how much longer you were going to keep that old wreck."

"I could fix it up easy enough if I wanted to," retorted Joe.

"Sure you could," Gus agreed. "No car ever gets so old that it can't be put in good running order—if you're willing to spend money; but there comes a time when its parts begin to lay down one after another and it doesn't pay to try to fix it. You've had your money's worth out of your car; now you'd better turn it over to the junk man. What kind of a car are you thinking of buying?"

"Whoever will give me the biggest allowance on the old bus gets my order," replied Joe. "You say all cars are about alike, so I'm going to shop around and see how much money I can save."

"And probably get stung doing it," predicted Gus. "I declare, Joe, you certainly don't show much sense sometimes. When did I ever say that all cars are exactly alike? What I said was that any modern car will give good service—and that's all I meant. Some cars are much better buys from a price point of view than others. And you'll generally get the biggest allowance offers from the dealers who sell the worst bargains.

"THE dealer who has the hardest time selling his cars usually is the most liberal with trade-in allowances. Besides, some manufacturers put a fictitious list price on their models just so the dealers can make bigger allowances. The thing to do is pick your car first and then find the dealer who'll give you the best allowance. Hello! What's that?—"

Gus broke off suddenly as the front door of the garage closed with a violent smash.

"I tell you you're cuckoo!" growled an angry voice from the shop. "That car's a lemon if there ever was one!"

"G'wan! You don't know what you re talking about!" came another equally heated voice.

"More grief!" whispered Gus, after peeping out the office window. "It's my cousins from up Winchester way. Another morning shot to pieces! Hello, folks!" he called out as he snapped the last buckle on his overalls and stepped out into view. "What's all the row about?"

"Well, you see it's this way, Gus," began one of the two as he fished a bundle of automobile catalogues and circulars out of his pocket. "Ben and I have decided to buy new cars this spring and I've been trying to get Ben to take my advice but he's so darn pig-headed he won't do it."

"Pig-headed, am I!" exclaimed Ben. "Maybe I am—because I know I'm right—but your dome sure is made of solid concrete—"

"THAT'S no way to start a visit," interrupted Gus, "but I suppose the argument is what brought you here, so let's go in the office and get it settled.

"I gather," he continued when they had settled themselves around the table with the literature spread out before them, "that you've each chosen a different make. What cars are you thinking of buying?"

"I could pretty near have guessed right on both of you," Gus smiled after they had belligerently announced their choices. "You still working in the tool room at the Manley works, Hank?" he inquired, turning to the man who was wearing the flannel shirt.

"You bet," Hank replied. "I'm foreman now."

"And you, Ben, I suppose, are still the leading legal light of Winchester?"

"I'm still practising law," Ben corrected him.

"HAVE it your own way," grinned Gus. "Anyway, each of you is an expert in one particular line. But you've driven all the way down here just to get my opinion on a line that neither of you is expert in—automobiles.

"The car you've picked, Hank, is fast. It's got lots of pep on the hills. It doesn't ride any too easy unless you fit it with shock absorbers and keep them adjusted just right. The motor will give good service if it gets just the proper care, and there are a number of other things about the car that require touching up every now and then if you want good service. But, balancing the advantages against the disadvantages, I'd say it was a mighty fine car."

Hank grinned triumphantly. "Told you so!" he snickered.

"On the other (*Continued on page 138*)

Kinks *That Will Help* Your Car

Auto Convertible into Bedroom—Garage Doors That Close Themselves—Handy Quick Acting Jack—Other Good Ideas

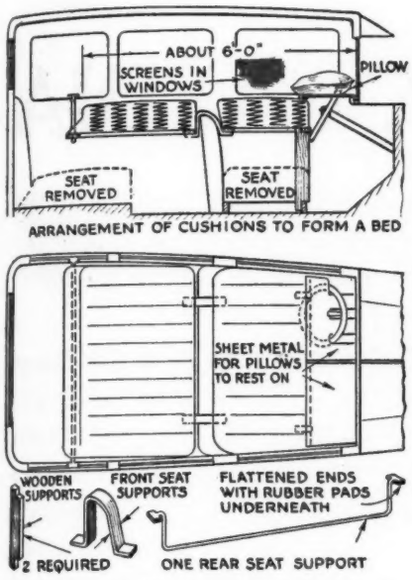


Fig. 1. Seat cushions can be made to serve as a mattress in camping. Screen two windows

A *Bed in a Motor Car*

HERE is an ingenious way to utilize the regular front and rear seat cushions of your closed car as a bed while auto camping. As you will note from Fig. 1, you will need to construct one long bracket to support the rear end of the rear seat cushion. The ends of this bracket rest on the rear window sills to fit a rubber pad on each end of the bracket. The two brackets that fit over the back of the front seat are heavy strap iron. If the front seats are divided you will need four brackets, two for each front seat. Wooden supports hold the front edge of the front seat cushion and a sheet metal support for the pillows completes the bed. A long roll-shaped cushion can be fitted into the space between the front and rear cushions if desired.

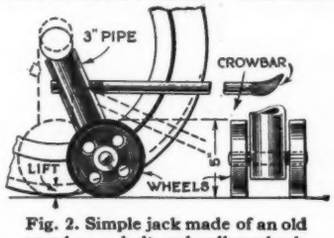


Fig. 2. Simple jack made of an old crowbar, a bolt and pulley wheels

A *Quick-Acting Jack*

WHILE the regular style of jack that you usually carry in the tool kit is, of course, adequate for emergency tire changes on the road, you will find that a simple quick-acting jack such as is shown in Fig. 2 will save a lot of back-breaking work in the home garage. The materials you need to construct this jack are an old crowbar, a piece of heavy three-inch pipe, a long half-inch bolt and two five-inch iron wheels. Ordinary crown pulleys will do nicely. The upper end of the pipe is rounded to fit the axle. Be sure to drill the hole for the crowbar at the proper angle. Then when the crowbar strikes the ground the wheels will have rolled just past center under the axle.

Back Through Garage Doors!

OPENING the garage doors, driving out and then having to get out of the car to shut the doors after you is a nuisance when you are in a hurry. By constructing garage doors after the fashion shown in Fig. 3 you will be able to back right through the doors, and they will close after you, eliminating the necessity for getting out to close them by hand. As you will note from the drawing, a rope or cable is arranged over pulleys so that swinging the lower half of the door down automatically raises the upper half. You will have to work out the locations of the pulleys to suit your own garage. Be sure that the lower half of the door is built strong enough to stand the weight of the car and use counterweights to assist the closing with rubber bumpers to take up the jar.

Tool Boxes in the Floor

IN LONG trips it is difficult to find room for extra tools. Fig. 4 shows how to solve the problem. If you will take up the floorboards in front of the rear seat you will find that there is plenty of room for at least one deep tool box and one shallow one. The latter is necessary to clear the exhaust pipe. Make the boxes of galvanized iron riveted together at the seams. Remember that the body with the tool boxes drops down much nearer the axle when the car goes over a bump, and allow plenty of clearance. The illustration also shows a neat arrangement for packing the curtain irons. The shallow tin box for small tools to slip under the driver's seat, also shown in the drawing, is particularly good for closed cars of the coach type, where the front seats tip forward.

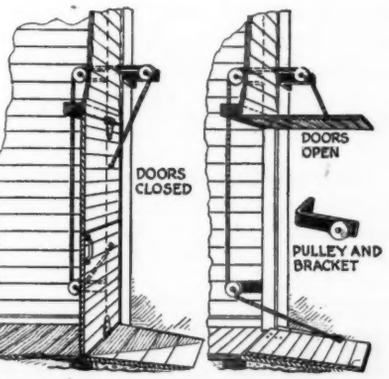


Fig. 3. Construction of garage doors that will close themselves after you have backed out

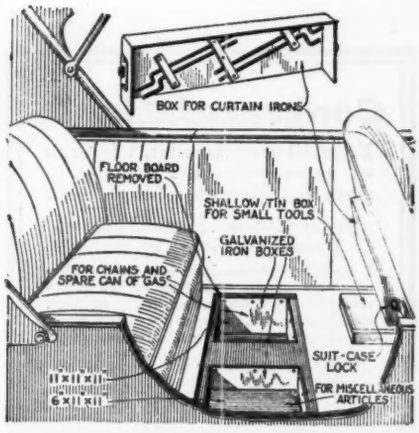

BOX FOR CURTAIN IRONS
FLOOR BOARD REMOVED
SHALLOW TIN BOX FOR SMALL TOOLS
GALVANIZED IRON BOXES
FOR CHAINS AND SPARE CAN OF GAS
SUIT-CASE LOCK
FOR MISCELLANEOUS ARTICLES
11 x 11 x 11
6 x 11 x 11

Fig. 4. Extra compartments for tools and odds and ends can be fitted under rear floorboards

Swinging Stop Light

MOST cars sold today are regularly fitted with stop lights, but here is a way to make yours more effective than the standard. Look over Fig. 5. In place of the regular stop light fit a board, and to the top of it attach an ordinary vacuum type windshield wiper. Replace the wiper with a lightweight tail-light. The rubber hose should be run to a valve on the dash board and the other side of the valve piped to the intake manifold of the motor. The bulb in the swinging stop light should be wired to the regular stop light switch, operated by the foot brake.

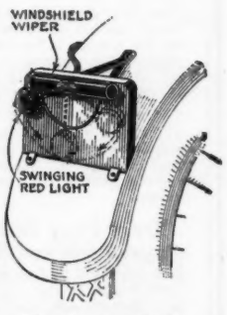


Fig. 5. A swinging stop light commands immediate attention

Ten Dollars for an Idea!

P. H. ASHBY, of Strathcona, Alberta, Canada, wins the $10 prize this month with his garage door suggestion (Fig. 3). POPULAR SCIENCE MONTHLY awards $10 monthly, in addition to regular space rates, for the best suggestion for motorists. Other contributions published are paid for at usual rates.

1768 IMPORTANT

160th Anniversary ENCYCLOPAEDIA at a NEW

YOU can now realize your lifelong wish to own the Encyclopaedia Britannica—the *genuine* Britannica, recognized the world over as the greatest library of knowledge in the world! For this great work is now available at a NEW LOW PRICE, and upon Easy Terms of Payment that *anyone* can afford. To those who have put off ordering a set, this 160th ANNIVERSARY SALE offers an opportunity to save many dollars on the very latest Britannica.

Congratulations!

From all over America, telegrams of appreciation are pouring in every day. Here are a few of them:

From Charles Evans Hughes, *Former Secretary of State:*

I heartily congratulate you on the Anniversary of the founding of the Encyclopaedia Britannica, an event of high significance and great public benefit in the systematic diffusion of knowledge.

From Andrew W. Mellon, *Secretary of the Treasury, Washington, D. C.:*

Please accept my congratulations on the one hundred and sixtieth anniversary of the founding of the Encyclopaedia Britannica. This publication has exerted a most profound and far reaching influence on education throughout the world and has performed a service of inestimable value in making readily available such an accurate and comprehensive body of knowledge.

From Sir Robert Borden, *Ex-Premier of Canada:*

Upon the one hundred and sixtieth anniversary of the founding of the Encyclopaedia Britannica, pray accept my congratulations and my best wishes for a fitting and inspiring celebration. It is indeed an event of marked significance having regard to the service of this great publication in the cause of education and culture.

From Dr. S. Parkes Cadman, *Brooklyn, N. Y.:*

The Encyclopaedia Britannica is by common consent the first work of its kind in the world. It has contributed in manifold and permanent ways to the culture of all English-speaking nations, as well as to other civilized lands.

I congratulate you upon its perennial youth and vigor. It reaches its one hundred and sixtieth anniversary with a wider range of information than ever before during its long and illustrious career.

From Mary Roberts Rinehart, *Author and Playwright:*

My gratitude and admiration to the Encyclopaedia Britannica on its one hundred and sixtieth anniversary. The amount of authoritative knowledge disseminated by it in that long period cannot possibly be estimated. Its wide information makes for civilization. Its contribution towards civilization is the largest made by any single agency. I am never without it.

From John Grier Hibben, *President, Princeton University:*

My hearty felicitations upon the 160th Anniversary of the founding of the Encyclopaedia Britannica. This great work has placed the intellectual world under a debt of deep gratitude. The Encyclopaedia Britannica's record of advancing knowledge forms a complete library within itself.

An Epoch-Making Event

The Britannica's 160th Anniversary is an event of tremendous importance from the standpoint of culture and education. And, in order to make this great event mean something tangible to the general public, the publishers of the Britannica have arranged for a special printing of the latest 13th Edition, to be sold at a price so low that *no one* need now be without this indispensable work.

Far in advance of this great sale, orders were placed for all the necessary materials. More than a million pounds of Britannica Opacity paper—inks and cloth and leather in correspondingly large quantities—have been purchased from the manufacturers at prices which only the Britannica could secure, owing to the immense volume of its business which is world-wide.

Complete and Authentic

The Encyclopaedia Britannica now, as always, stands head and shoulders above every other work of reference ever published. Its commanding position has never been successfully challenged.

That is why one of the publications of the American Library Association calls it "the most famous encyclopaedia in English."

That is why more sets of the Britannica have been sold than of all other encyclopaedias *combined*.

Today nearly 500,000 sets of the Britannica are owned by thinking ambitious people. They cherish this great work as the very foundation of their libraries.

An Incomparable Value

All other works of reference are pygmies beside it. With its 50,000,000 words, the Britannica contains at least *twice as much reading matter* as the next largest work of reference. Yet YOU can actually buy the Britannica at *a lower price!*

More famous Americans have written for the Britannica than for any other American work of reference; and every other civilized country in the world is also represented in the Britannica by the writings of more authorities of that country than you will find in any similar publication in *any* language.

The Encyclopaedia Britannica was founded in 1768. Since then numerous editions have appeared, until today the latest, the 13th Edition, stands in a class of its own, un-

Send for FREE Booklet NOW—

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

ANNOUNCEMENT 1928

SALE of the BRITANNICA LOW Price!

equaled and unrivaled. From time to time, other publishers have tried to make cheap imitations of it, in a dozen different languages, but these have died out after one or two editions because none of them could stand comparison with the Britannica.

A Wonderful Work that Cannot Be Imitated

There has always been something in the spirit of this great work, handed down from one generation of editors to another—some splendid spirit of foresight and thoroughness and impartiality and nobility of purpose—that imitators could never copy.

The Britannica is not the work of hack compilers, but of the world's greatest authorities—more than 2500 of them—chosen from *all* countries for their first-hand knowledge of the subjects upon which they have been invited to write. Their articles are *signed*—thus, when you own the Britannica, you get your knowledge first-hand, from the men and women who know their subjects best.

An Exclusive Feature—the Marvelous Index Volume

The Encyclopaedia Britannica is the *only* work of reference that has an entire volume devoted to an *Index*—an index which cost more than $150,000 to produce. This remarkable Index volume, with its 600,000 references, gives you complete command of all the rich resources of this comprehensive work. It is like a huge magnifying glass which enables you to pick out, in a moment's time, the vital knowledge that you must have. A reference work without an index is often absolutely useless. The information *may* be there, but you can't find it. That is never true of the Britannica, which places all the knowledge in the world at your command for *instant* use.

While this Offer Lasts Here is What You Get

The complete 13th Edition of the Encyclopaedia Britannica, comprising the 28 volumes of the latest standard edition, 3 supplementary volumes and an enlarged Index—32 volumes in all!

You get it in the large-page, large-type NEW FORM (32 volumes bound as 16) containing 33,000 pages; 50,000,000 words; 15,000 illustrations, including 550 full page plates (many in color) and 640 maps, on which more than 150,000 separate places are indexed and shown.

And you get all this at a NEW LOW PRICE—an actual saving of many dollars—*If You Act QUICKLY!*

Prove It To Yourself

Before you risk a dollar of your good money, you can prove to yourself that this is an opportunity you cannot afford to miss.

You have probably always wanted the Britannica, but you have never *needed* it half so much as you do today. To prepare yourself to meet the challenge of tomorrow—to plan and organize your life—to help your children find their life interests—you *must* have the FACTS which *only* the Britannica can give you.

Nothing else can take the place of the Britannica in this respect. Its value cannot be measured in dollars and cents. It is the *one* work you and your family cannot afford to do without.

You owe it to yourself to get full particulars of this great work; also details of this great 160th Anniversary Sale Price, which brings this indispensable work within reach of *every* home.

Never before has a complete new edition of the Britannica been offered at such an amazingly low price.

New Illustrated Booklet FREE

Write for it now—TODAY. Avoid delay. Tear out and fill in the coupon below. It will bring you full particulars of this epoch-making sale, together with handsome illustrated Booklet which tells all about the latest Britannica, and explains the Easy Terms of Payment. Tear out this Coupon NOW—before you turn this page. And drop it in your nearest mail box before the last collection tonight.

Mail Coupon TODAY →

The ENCYCLOPAEDIA BRITANNICA, Inc.
342 Madison Avenue, New York *P.S.M.8-B-1*

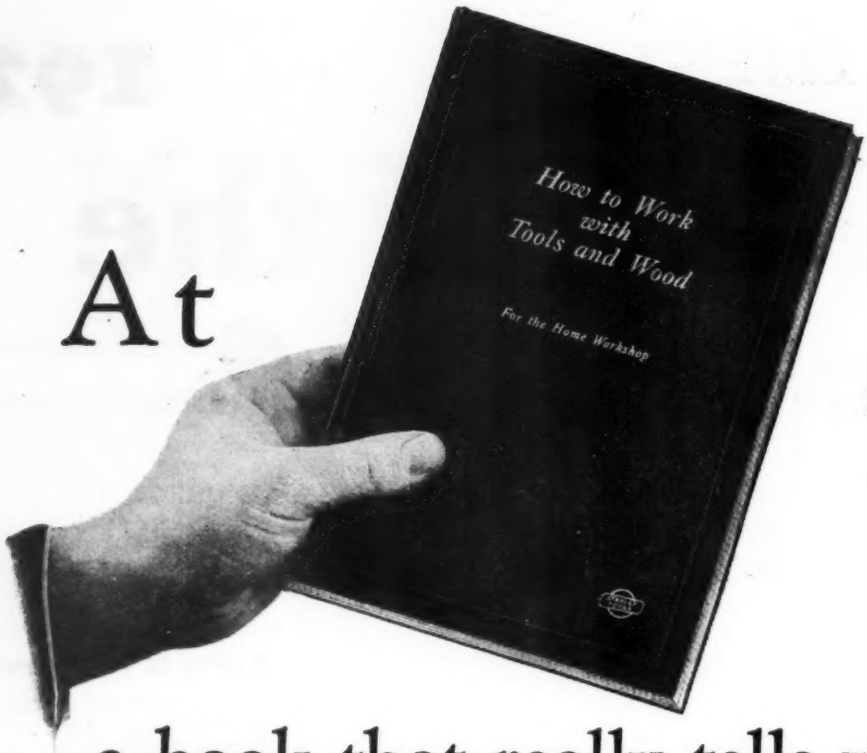
Please send me, without obligation on my part, your FREE Booklet; also particulars of your NEW LOW PRICE Offer and full details of your Easy Payment Plan.

Name _____

Address _____

City _____ *State* _____

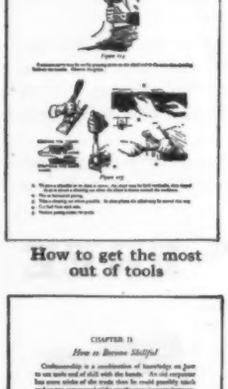
This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.



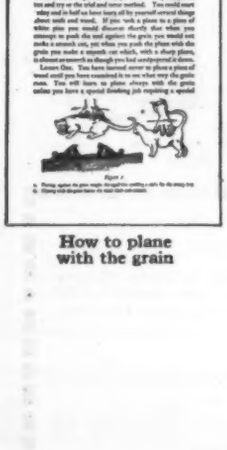
At last!

a book that really tells you—

How to work with Tools and Wood



How to get the most out of tools

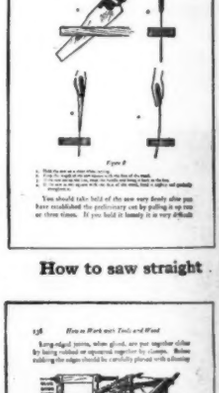


How to plane with the grain

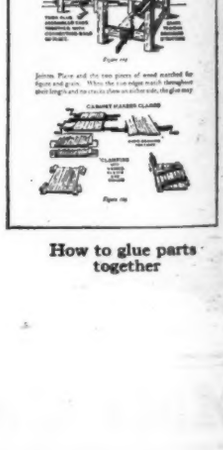
Here is a book which every tool-user should own. It takes all the mystery out of using tools, selecting materials, and planning and finishing work. It enables you to repair furniture, put up shelves and do many other odd jobs about your home. It opens the way to make many useful objects—from a book rack to a kitchen cabinet.

This is a complete guide. Every question you have ever wanted to ask about tools and woodworking is answered in this book. Over 150 illustrations and diagrams make it valuable to the advanced worker as well as the beginner. A complete cross-index makes it an instant reference book on the use and care of tools, and the selection of lumber, paint, varnish, etc.

Contains 185 pages. Durably bound in blue cloth. This book, if sold in the regular way would cost you at least $2.00. But the price is only $1.00—at your hardware dealer's. If he does not carry it in stock, send us one dollar in money order, check, or stamps for your copy. THE STANLEY WORKS, New Britain, Conn.



How to saw straight

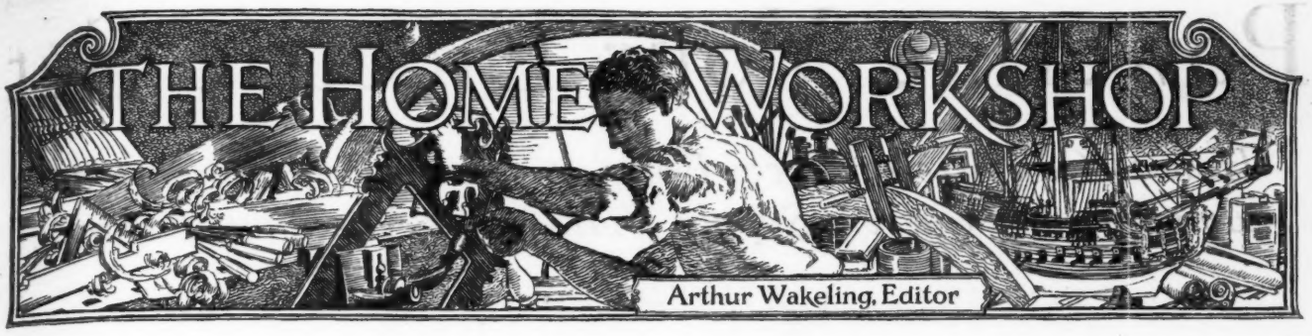


How to glue parts together

STANLEY TOOLS

The choice of most carpenters

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.



The Simplest Flying Model

Anyone Can Build Successfully This Little Single-Stick Monoplane

By J. D. BUNCH *and* A. F. KOCH

The success of commercial aviation tomorrow lies with the youngsters of today. From among them will come our successful designers, manufacturers, promoters and flyers. The national miniature aircraft tournament conducted by the Playground and Recreation Association of America will help direct this enthusiasm in a practical way and will help insure the future air supremacy of the United States.
—Commander Richard E. Byrd.

THERE is a real thrill in flying airplane models. It doesn't matter how old you are or whether you know anything about aviation or not; you can't escape the fascination of the game. But first you have to get into it, and to do that we can think of no better way than to build the model illustrated.

Known as a hand-launched single-stick tractor monoplane, it is one of the simplest yet most interesting models. It can be made more quickly than almost any other type of plane and the cost for materials is trifling. It is, nevertheless, an excellent flyer.

Building the model is much easier if you have full size drawings of the various parts. These you can obtain by sending for POPULAR SCIENCE MONTHLY Blueprint 82 (see page 106). The experienced model-maker knows well the value of having large drawings to work from; for the beginner they are even more essential, for he has either to draw his own full size layouts, which is often the hardest part of the work, or take advantage of blueprints such as those published as an auxiliary service for readers of POPULAR SCIENCE MONTHLY.

The fuselage of this model is a single stick of white pine ⅛ by ¼ by 30 in. This must be straight grained and sand-papered to a smooth finish.

First the propeller shaft bearing is installed. This may be purchased from a model supply company or you can make it from a ½ in. long piece of 1/16 in. inside diameter brass tube with 1/64 in. thick wall. The tube must be flared slightly at the front end so it will not slip back through the threads. Cut a block of white pine ¼ by ¼ by ⅛ in. and groove it along the top to make a cradle for the bearing. Glue it to the top of the fuselage and bind the bearing in place. Before the glue dries, true the bearing up along the fuselage.

Make a rear rubber hook as shown and bind it to the fuselage.

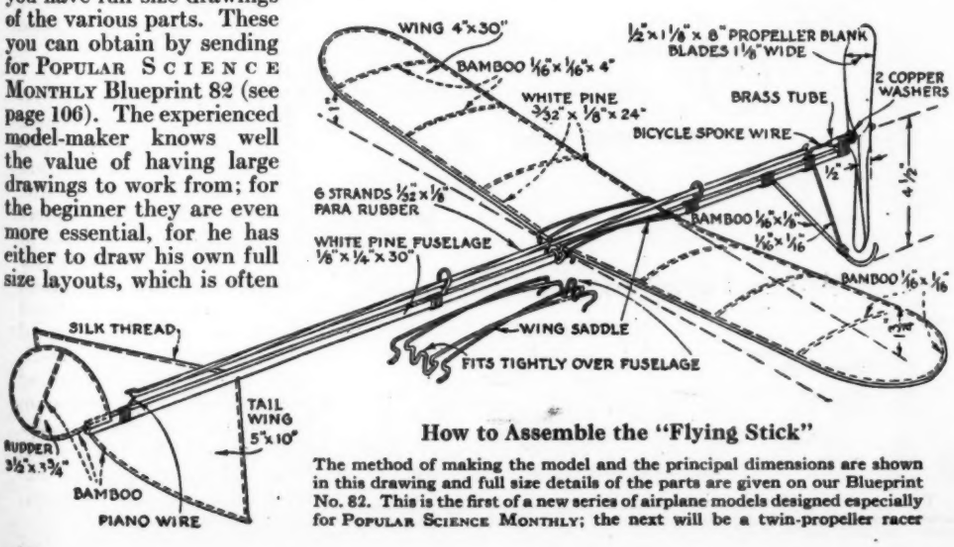
The skid, or propeller guard, is made from a piece of bamboo 1/16 by ⅛ by 7 in. It is bent, as shown, around the tip of the propeller, then up to meet the fuselage 3¼ in. from the nose, and then parallel to the fuselage for ¼ in. Glue and bind the skid to the underside of the fuselage. The skid brace, or front leg, is 1/16 by 1/16 by 4⅛ in. It is bent parallel to the fuselage at one end and to the skid at the other. It should meet the skid 3½ in. from the fuselage and should meet the fuselage 1¼ in. from the nose. It is bound in place and glued.

Koch shows how to hold the 30-in. model when launching it. Both he and Bunch fly large as well as small airplanes, for they are commercial aviators

Bamboo is bent by heating it over a candle and forcing it into the desired curve. Hold it that way for a moment until it cools. Whenever possible, bend bamboo with the glossy side on the outside of the curve.

The "cans," or rubber guides, which keep the strain of the motor from distorting the frame, are made of 1/32 in. diameter piano wire. There are two of these, one 7 in. and the other 18 in. from the nose. Loop the wire into a ring ½ in. in diameter, bend the ends parallel to one another for ⅛ in. and then bend them at a right angle to the loop for ¼ in. Glue and bind the cans to the fuselage.

The tail wing is fitted to the under-side of the fuselage. The spar is bamboo 1/16 by 1/16 by 10 in. It *(Continued on page 128)*



How to Assemble the "Flying Stick"

The method of making the model and the principal dimensions are shown in this drawing and full size details of the parts are given on our Blueprint No. 82. This is the first of a new series of airplane models designed especially for POPULAR SCIENCE MONTHLY; the next will be a twin-propeller racer

Powering Your Electric Set

How to Complete the New Popular Science Receiver with an Amplifier and Current Supply Unit Giving Maximum Volume

By ALFRED P. LANE

IN THE February issue of POPULAR SCIENCE MONTHLY we described the construction of a new electric radio receiver. To complete this receiver you will need to build either the high power amplifier and current supply unit to be described here or the lower powered and less expensive unit to be described next month.

This amplifier is the most powerful one you can assemble with apparatus now available to the home builder. It uses two 210 tubes in a push-pull circuit, and the volume without distortion will equal that of the band playing in the studio, provided, of course, that you use a good loudspeaker. The tone quality is superb. Low notes come through without thumping or rumbling, and the entire useful musical scale is reproduced so that musical instruments or voices sound natural and lifelike even at tremendous volume.

The construction of the amplifier and current supply unit is shown clearly in Figs. 2 and 4, and the wiring in Figs. 1 and 3.

In order to eliminate the possibility of magnetic interaction between the power transformer, the choke coils and the push-pull transformers, the instruments have been spread out on a long, wide baseboard.

THE complete electric set, consisting of the receiver described last month (Blueprint 79) and the power unit described here, is designed to fit into a standard factory made console type cabinet or into the console cabinet made at home from Blueprints 70 and 71. The receiver fits in the upper compartment and the power unit in the lower one ordinarily used for batteries.

The first step in the construction is to make up the baseboard. The one used on the unit shown in the illustrations is 12¼ in. wide and 26 in. long. This is as large a baseboard as can conveniently be gotten into the lower compartment of the console cabinet chosen for the set. Crosspieces should be screwed to the bottom of the baseboard at the ends and in the middle to add strength and to allow room for passing some of the wires underneath the baseboard. Before fastening these pieces on the baseboard, be sure to drill a row of holes through them so that the wires can be passed through from one end of the unit to the other.

Blueprint Is Ready!

ORDER Blueprint No. 80 (see page 106). It will prove helpful in building this new high power amplifier and current supply unit. Many of the lesser details are included on the blueprint that could not be given here for lack of space. The Popular Science High Power Unit for Electric Radio Set and the receiver itself (Blueprint No. 79) have been tested and approved for home construction by the Popular Science Institute of Standards.

The three binding post panels can be made of shellacked plywood or from bakelite or hard rubber. They are mounted by means of long screws that pass through the small wood supporting blocks.

You will need these parts to build the high power amplifier and current supply unit for the Popular Science Electric Radio Set:

A—Power transformer with 1½-volt, 2½-volt, two 7½-volt windings and a 750-volt winding tapped at 550 volts.
B1—Choke coil, 20 henries at 125 mils.
B2—choke coil, 50 henries at 50 mils.
C1, C2, C3, C4, C5 and C6—2-mfd. condensers rated at 1000 volts direct current working voltage.
C7—1-mfd. condenser rated at 600 volts.
C8 and C9—1-mfd. condensers rated at 160 volts.
D1—input transformer.
D2—output transformer.
R1—41,000-ohm heavy duty fixed resistance, tapped at 32,000, 21,000, 16,500, 12,500 and 9,000 and rated not less than 40 mils.
R2—1000-ohm fixed resistance rated to carry not less than 50 mils.
R3—25,000-ohm fixed resistance.
S1, S2, and S3—standard X-type vacuum tube sockets.
Eight binding posts, flexible enameled fabric-covered wire, 1 UX281 rectifying tube and two UX210 amplifying tubes.

IT IS not necessary to use a baseboard made of one single piece of wood. The crosspieces permit you to assemble the baseboard from several pieces. The model power unit shown in the illustrations has a baseboard made up of three pieces which are firmly held together by screws through the crosspieces. Use boards ⅞ in. thick. The parts are heavy and should be strongly supported.

Study the illustration in Fig. 2 and the picture wiring diagram of Fig. 3. They will show you how to place the apparatus on the baseboard. Note particularly the holes that will have to be drilled to pass the wires along under the baseboard. In the picture wiring diagram of Fig. 3 the solid wires are above the baseboard and the dotted wires are beneath it. The wiring is so simple and there is so much space that you will have no difficulty in following the diagrams without any special instructions. Remember that you are dealing with very high voltages and take special care with every connection to make sure that it is firmly soldered so that it will not come loose and cause a short circuit.

THE leads on the transformer will be found long enough to reach directly to the points to which they are to be soldered except for the 7½-volt leads that connect to the filament terminals of sockets S2 and S3, the center tap of this same winding, which connects to one end of R2, and the center tap of the 2½-volt winding, which goes to the 45-volt binding post by way of the 9000-ohm tap on R1 and one terminal of condenser C8. These leads from the transformer are extended by means of the regular hook-up wire.

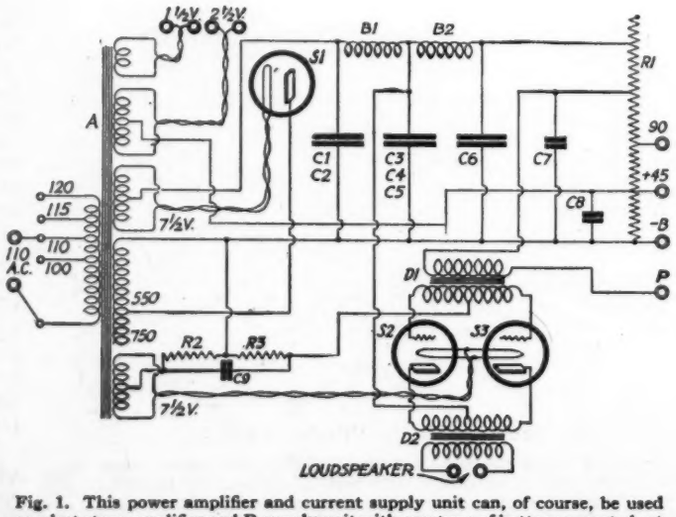
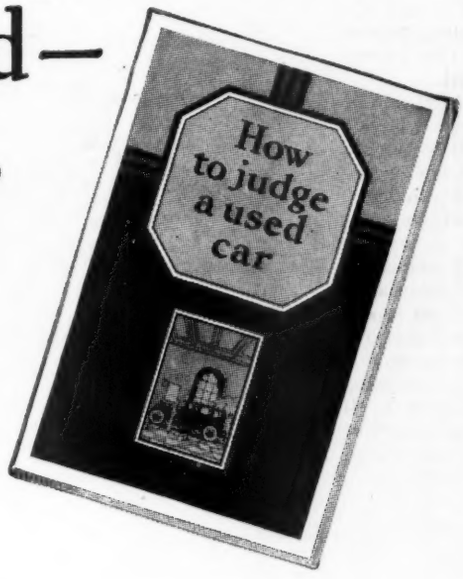


Fig. 1. This power amplifier and current supply unit can, of course, be used as a last stage amplifier and B-supply unit with any type of battery operated set

(*Continued on page 84*)

Before you buy a used car from a friend—

Send for THIS FREE BOOK!



Pledge to the Public
on Used Car Sales

1 Every used car is conspicuously marked with its price in plain figures, and that price, just as the price of our new cars, is rigidly maintained.

2 All Studebaker automobiles which are sold as CERTIFIED CARS have been properly reconditioned, and carry a 30-day guarantee for replacement of defective parts and free service on adjustments.

3 Every purchaser of a used car may drive it for five days, and then, if not satisfied for any reason, turn it back and apply the money paid as a credit on the purchase of any other car in stock—new or used. (It is assumed that the car has not been damaged in the meantime.)

To the Public: We pledge adherence to the above policy in selling used cars.

Your Studebaker Dealer

IF you were about to buy a used car from a friend, would you know how to determine its fair market price? Do you know why some dealers mark their prices in code instead of plain figures? Do you know how to tell what year any used car was built?

You will find the answer to these questions and many others that any buyer of a used car should know in this free book, "How to Judge a Used Car." It tells you what to look for and what to avoid in purchasing a used car. It is based on the long experience of experts in buying used cars for Studebaker dealers—their sound, practical advice may be the means of saving you time and money. Send for it at once!

Studebaker is only too glad to help you get the greatest value in a used car for your investment. Because Studebaker dealers believe in this policy, they have adopted this famous Pledge. Wherever you see this Pledge displayed you can buy a Certified Studebaker with absolute assurance that it is worth what the dealer asks and will do what he says.

Mail this coupon for your copy of "How to Judge a Used Car"

THE STUDEBAKER CORPORATION OF AMERICA
Department C56, South Bend, Indiana

Please send my copy of valuable free booklet, "How to Judge a Used Car."

Name .....

Street .....

Town ..... *State* .....

STUDEBAKER

The Great Independent

Figuring from the minus-B end of R1, the 45-volt binding post is connected at 9000 ohms, the 90-volt binding post at 16,500, the wire from one terminal of condenser C7 at 21,000; and the wire from condensers C3, C4 and C5, which are in parallel, taps in at 32,000 ohms. The 41,000-volt tap is not used.

Before connecting the binding posts that are used for the light current supply to the primary taps of power transformer A, call up the office of the local power company and find out what the average voltage is in the lighting circuit in your neighborhood. Then connect the zero tap to one binding post and the next *higher* tap than the figure you get from the power company to the other binding post. If the voltage in your locality is somewhere in the neighborhood of 110 volts, for instance, use the 115-volt lead, and so on.

The block of filter condensers C1, C2 and so on are held in place by a heavy copper wire around over the top and another around them the other way near the base. This wire also serves as a common minus-B connection.

Be sure to ground the cases of all condensers and the frames of transformer A and the chokes B1 and B2. This means that you are to clamp a wire under one of the screws that holds transformer A to the baseboard and solder the other end of it to the minus-B wire at any point. Do the same for the two chokes. You will find that the holding wire can be tightened up enough to ground the cases of the condensers if you scrape a bright spot at the points where they touch each other.

TAKE especial care to see that the 1½- and 2½-volt leads from transformer A are solidly connected to the binding posts. A poor connection at this point will seriously interfere with the operation of the outfit. Carefully tape the 750-volt lead and the unused primary leads and push them down out of the way.

After you have finished wiring the unit and have rechecked your work several times to make sure that there are no errors, take a keyhole saw and cut out a large enough piece of the back of the lower compartment of the console cabinet to allow you to place the power unit inside. Leave the back of the cabinet open. These power tubes get quite hot and the opening will allow air to circulate around them to keep them cool. If the tubes are operated in a closed compartment, the excess heat will shorten their life.

Assuming that the radio receiver described last month is in the upper compartment, drill holes in the floor of the upper compartment so that you can pull through the leads from the receiver and connect them to the similarly marked binding posts on the power unit in the lower compartment. Leave the leads long enough so that you can pull the receiver out of the cabinet far enough to take the covers off the shield boxes.

Now insert UX226 tubes in sockets G1, G2, G3 and G5 of the receiver and put a UX227 tube in socket G4. Then put a UX281 tube in socket S1 of the power unit and insert UX210 tubes in sockets S2 and S3 of the power amplifier.

Connect the antenna and ground and the loudspeaker to the binding posts provided on the set, and then plug the cord from the power unit into the nearest electric light socket. The UX 281 tube should light to a dull red and the 210 tubes should glow quite brightly. The 226 tubes light about like the 281 and after thirty seconds or so the 227 tube will also glow.

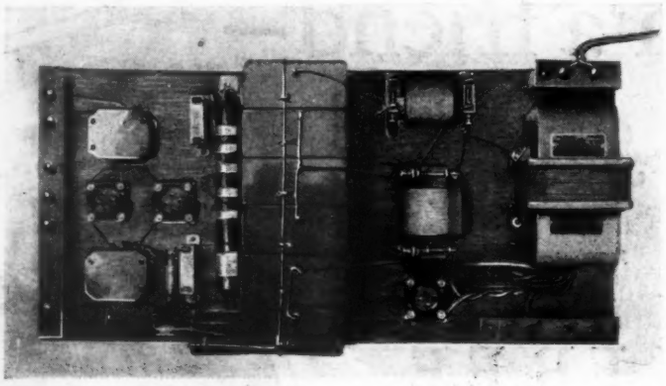


Fig. 2. The high power amplifier and current supply unit as seen from above. Note spacing of instruments to eliminate magnetic interaction

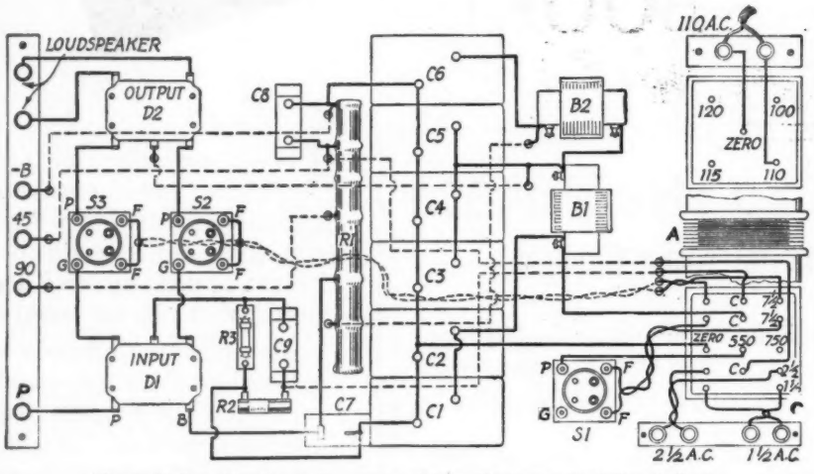


Fig. 3. Follow this picture diagram in wiring. The heavy black lines indicate wires above the baseboard; dotted lines, indicate those below. The ends of power transformer A have been turned so that connections are clear

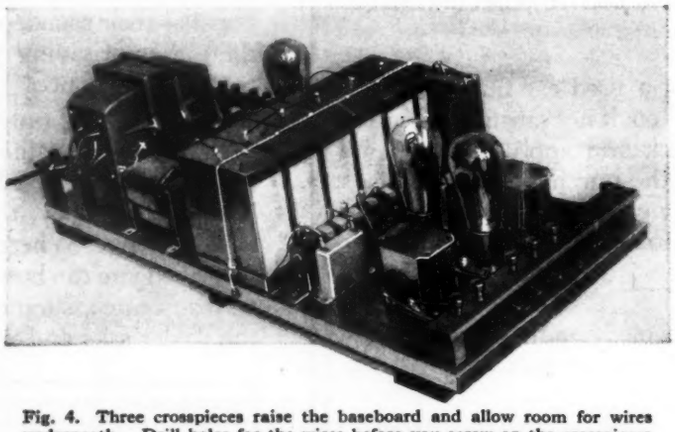


Fig. 4. Three crosspieces raise the baseboard and allow room for wires underneath. Drill holes for the wires before you screw on the crosspieces

IF EVERYTHING has been done exactly according to instructions, you will hear a noticeable hum when you first turn on the current. This hum will continue till the 227 heats up; then it will die out to a very low figure, so low that you will not notice it at all unless you listen for it in a quiet room.

If all the tubes do not light as described, shut off the current at once and do not turn it on again until you have definitely located the trouble. *Caution: Never touch any part of the power amplifier and current supply unit while the current is turned on. Never attempt to operate the outfit unless the specified tubes are in all sockets.* If, for instance, one of the 210 power amplifier tubes in sockets S2 or S3 should burn out, turn off the current at once. The receiver would operate with only one 210 tube, but the tube would be severely overloaded, the plate of the tube would get red-hot and be destroyed in a very short time.

All operating voltages are fixed. There is nothing to adjust in the power amplifier and current supply unit. The values of the various resistances are such that the radio-frequency amplifier tubes operate at 95 volts with a C-bias of 6 volts and they draw close to 3 mils each. The detector tube gets 45 volts B-current, and the first audio amplifier tube has 175 volts applied to its plate with a 12-volt C-bias. It draws 5½ mils. The 210 power tubes operate on 450 volts B with a C-bias of 35 volts and they draw 40 milliamperes.

The only adjustments you have to make are in balancing condensers C4 and C5 in the receiver, and you have to turn potentiometer E5 to the point where the hum is lowest. This latter adjustment has to be made in a quiet room with the loudspeaker fairly near your ear.

You must make yourself a special screw driver to adjust condensers C4 and C5 in the set. This should consist of a piece of wood slotted at one end with a washer or other thin piece of metal forced into the slot and *(Continued on page 116)*

Electric Drill
No. 612—½'

The DRILL MASTER

MASTER of DIFFICULT WORK!

DESIGNED by Millers Falls Company to do everything an electric drill has ever done — better, quicker, and easier. Millers Falls is *your* drill. You'll want it the first time you pick it up. The grip is just right for easy handling of all the power you'll ever need — built for good work in close quarters.

Millers Falls is not satisfied merely to bore holes. There are too many other places where help is needed. Millers Falls has prepared a free booklet — based on 60 years of tool experience — telling some of the many new practical ways it can help in your automobile work this spring.

See this new drill. Let it tell its story in your own hands, and send the coupon today for this valuable book on new uses.

Condensed
Specifications, No. 612

Motor—Universal, operates on D. C. or A. C., up to 60 cycles; furnished for various voltages.

Armored attachment plug. Ventilated aluminum housing. Brushes quickly replaced. Greased lubrication throughout. Light weight for easy handling

The best dealers sell Millers Falls Tools

MILLERS FALLS COMPANY
Millers Falls, Massachusetts

MILLERS FALLS TOOLS
SINCE 1868

©MFC 1927

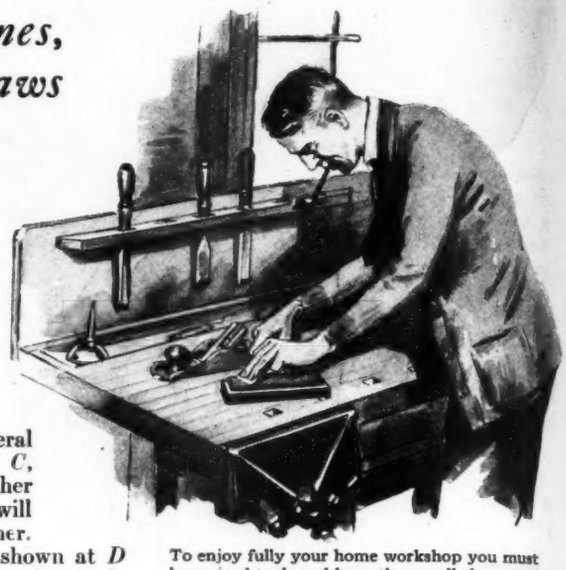
MILLERS FALLS COMPANY, Millers Falls, Mass.
Show me what the Millers Falls Drills can do.
Name
Address
No obligation of course

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

How to Care for Your Tools

Hints on Sharpening Chisels, Planes, Gouges, Scrapers, Auger Bits and Saws

By CHARLES A. KING

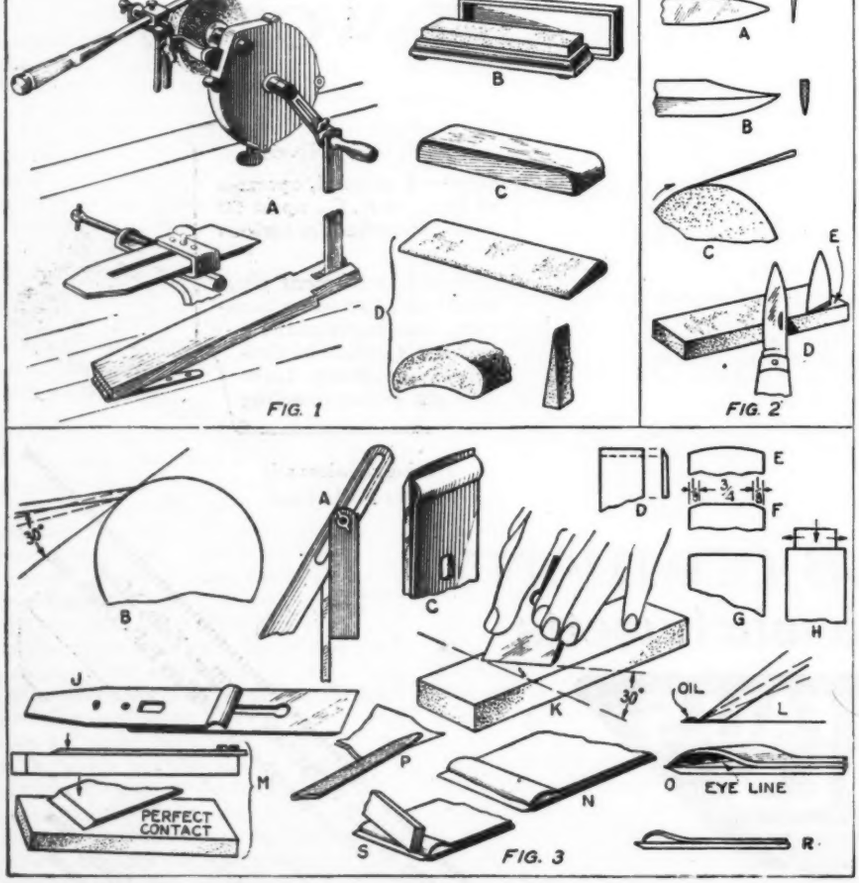


To enjoy fully your home workshop you must have good tools and keep them well sharpened

HOME workers and manual training pupils often seem to think that time spent in sharpening tools is largely wasted. They prefer to "put to more strength," in the words of the Biblical philosopher who wrote: "If the iron be blunt, and he do not whet the edge, then must he be put to more strength: but wisdom is profitable to direct" (Eccles. 10:10). Even apprentices are well advanced in learning their trades before they attain wisdom in the realization that time spent in sharpening tools will be more than repaid in the quantity and quality of their work.

Our discussion will be centered around woodworking tools, for they are more commonly used in the home workshop than others. A bench grinder (*A*, Fig. 1) with a 6 by 1 in. wheel will give satisfactory results in sharpening all woodworking tools and for general grinding. It can be converted to a foot power grinder by adding a treadle, which allows both hands to grasp the tool. A combination oilstone or whetstone *B*, 1 by 2 by 6 in., coarse on one side and fine on the other, which is set in an iron or wooden box to prevent the cutting surface from becoming glazed with dust, is an excellent general purpose stone. A strop *C*, made of a piece of leather glued or tacked on wood, will make a keen edge a little keener. Slip stones similar to those shown at *D* are necessary if gouges or carving tools are to be sharpened.

From the time our primeval ancestor discovered that a broken bone or a clamshell could be worn to a cutting edge on a flat stone, the knife has been the universal tool. For general use the knife may be sharpened as at *A*, Fig. 2, but a knife for whittling should be similar to *B*. Lay the knife upon the grindstone tangent at the edge as at *C* and turn the stone toward the edge. Move the knife forward occasionally to maintain a nearly straight surface from the edge to the back. Reverse hands and grind the other side. Keep the knife moving back and forth the entire length of the edge to prevent heating. When a wire edge or minute burr turns over, the edge is finished.



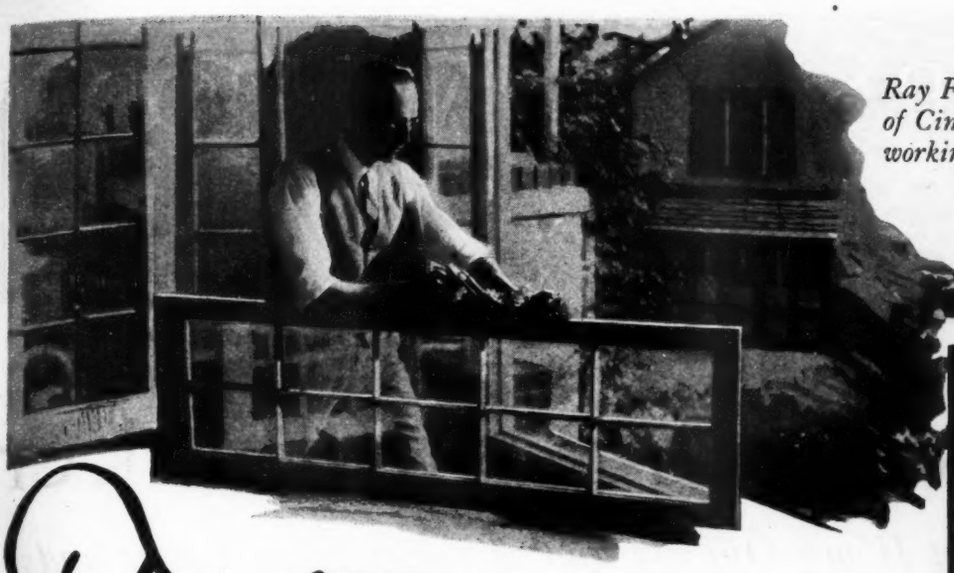
For keeping your tools in condition you need a bench grinder, a whetstone, a strop, and one or more slip stones, as in Fig. 1. Methods of sharpening knives and planes are illustrated in Figs. 2 and 3

LAY the knife on the whetstone as at *D*, pressing lightly upon the cutting edge so the back edge will clear the stone a very little as at *E*. Remove the wire edge by drawing the knife across a piece of wood and give a few more strokes upon the whetstone, finishing upon the strop, if desired.

Workmen seldom think of the bevel of a cutting tool in degrees; they are guided by the eye and the "feel" of the tool. A rather thin edge is preferred in working soft wood, while a somewhat thicker edge will stand up better on hardwood and for general purposes. A thin edge is better for a paring chisel, and a thicker edge for a mortising chisel.

In deference to definition we must mention an angle; most cutting tools are ground to a 25- or 30-degree angle. Set a bevel at 30 degrees and test the bevel of a plane cutter or chisel as at *A*, Fig. 3. It is important that the bevel be true the entire width and thickness of the iron, though the periphery of the wheel will make the bevel a little hollow as at *B*.

The bench grinder may have a tool rest that can be moved from right to left, in which the tool may be clamped as shown in Fig. 1; this insures accuracy. Usually the professional mechanic prefers a stationary rest and guides the tool by holding his fingers in one position against the rest. When grinding a plane cutter, set the cap iron back from the cutting edge about ⅛ in. as at *C*, Fig. 3, and use it as a guide for squareness instead of testing (*Continued on page 126*)



Ray F. Kuns of Cincinnati, O. working at home.

WHETTING THE PLANE BIT ON THE "VETERAN" CARBORUNDUM STONE

For 17 years

Mr. Kuns has used the same Carborundum Stone!

A partial list of things built by Mr. Kuns:

- 4 Automobile bodies
- 1 Boat
- 1 Radio
- 1 Garage 18 x 30
- 1 Rear porch to apartment
- 2 Sets of house screens
- 6 Dining chairs
- 1 Dining table
- 1 Buffet
- 1 Kitchen cabinet
- 2 Rocking chairs
- 1 Easy chair
- 1 Bed, 1 Dresser
- 1 Chiffonier
- 3 Lamps
- 1 Desk and Library Table, Art Jewelry and Hammered Copper Work

HERE is a man who has become expert in home craftsmanship. He is nationally known through his work—all done in spare time—and he started right because he followed experienced workmen like carpenters and cabinet makers in using this handy sharpening stone to keep "edges keen and cutting clean."

Today his original Carborundum Combination Stone is still performing perfectly. He credits to it a proper share in his success. It has served him continually, has worn uniformly, and still gives his tools a right working edge.

Mr. Kuns bought his Carborundum Combination Stone from his hardware dealer. It will pay you to get one; see YOUR dealer.

Send for Carborundum Catalog P-1

CARBORUNDUM *is the manufactured abrasive; a hard, sharp, fast-cutting material. This Combination Stone does double duty. One side is coarse grit for starting your edges, and the other side is fine grit for finishing.*

Carborundum

REG. U. S. PAT. OFF.

ABRASIVE PRODUCTS

THE CARBORUNDUM COMPANY, NIAGARA FALLS, N. Y.

CANADIAN CARBORUNDUM CO., LTD., NIAGARA FALLS, ONT.

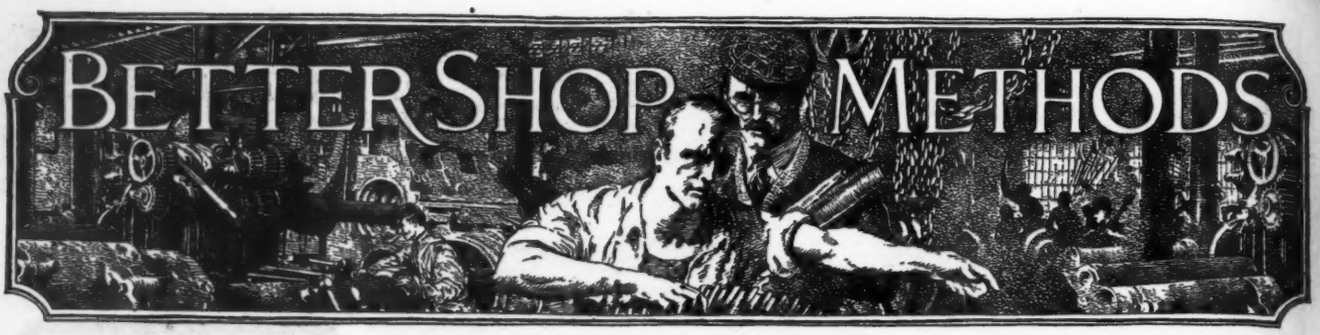
Sales Offices and Warehouses in New York, Chicago, Boston, Philadelphia, Cleveland, Detroit, Cincinnati, Pittsburgh, Milwaukee, Grand Rapids

The Carborundum Co., Ltd., Manchester, England

Deutsche Carborundum Werke, Dusseldorf, Germany

Carborundum is the Registered Trade Name used by The Carborundum Company for Silicon Carbide. This Trade Mark is the exclusive property of The Carborundum Company.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.



Tricks of the Toolmaker

How to Lay Out Work Quickly and Accurately on Lathe and Milling Machine—Jigs, Fixtures, Piercing Punches and Dies

By HECTOR J. CHAMBERLAND

NEW stunts in laying out machine-shop work, although they may appear to save time, are often lacking in either accuracy or practicability.

Anyone familiar with this line of work will admit that the method of using movable buttons is hard to beat so far as the average shop is concerned. Manufacturing plants engaged extensively in making jigs and the like are always on the lookout for production equipment and use jig boring machines, on which the spacing is done by the vernier system so that even slight errors are practically eliminated. The ordinary shop, however, has to be content with the movable buttons and a good lathe and a milling machine.

A practical and accurate method to lay out work is to finish the piece to standard dimensions, grinding it if necessary, and use short parallels clamped or screwed to the sides, as in Fig. 1. This method is excellent in such work as matching piercing punches and dies.

An example is shown in Fig. 4, page 108. It is a piercing punch and die for hack saw backs. The boring is done in machine steel plates, which are fitted in turn to the die and punch holders. The punches and bushings are held in the plates with set screws.

Fig. 1. When holes are to be laid out with extreme precision, measurements can be made with a micrometer, buttons and parallels, as shown at the left. The parallels can be clamped to the work in some cases, otherwise they are fastened with screws, as in this instance

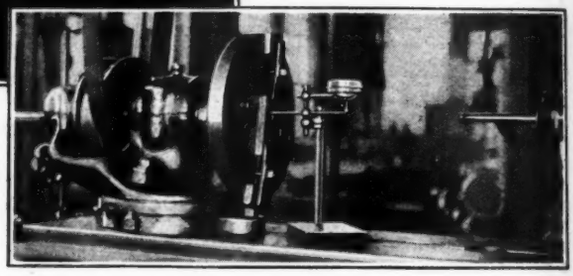


Fig. 2 (below). Truing up a hole that is to be ground and lapped in a plate for use as a distance testing fixture. A drawing of the plate is given in the lower part of Fig. 5

If the size of the work does not allow the use of clamps to hold the parallels for measuring, small holes are drilled and tapped at convenient places. The parallels may be of any length, if accurate.

A good lathe may be depended upon to execute accurate work. Before boring in the lathe, one must exercise care in strapping the work to the faceplate and have it well balanced. Should the work shift slightly, the deviation might be in any direction, whereas if the boring is done on the milling machine, the work has very little chance of changing position.

Figure 4 gives an idea of an operation well fitted for the milling machine. The holes are located, drilled and bored 1/16 in. smaller than their finished size and tested with the parallels and a plug gage. Corrections, if necessary, are made with the aid of the dial indicator.

In this case the work is accurately squared and strapped to the table. The vertical fixture also should be set with the indicator, using a 1/2-in. cylindrically ground piece.

Provided the equipment is in good condition as a whole, no trouble should be experienced in spacing, and the boring can be done without any previous layout. A start is made on side *A*. The back lash is eliminated at all times and a piece of .001 in. thick paper is used between the side and the plug gage in the chuck. The .625-in. spacing of the No. 1 hole is first taken and the work continued towards side *C*, repeating the operation as before. After the holes have been bored to 3/16 in. and checked with a plug gage and parallels, the micrometer will show the accuracy of the machine.

If the location is off in either of the four directions, the (*Continued on page 108*)

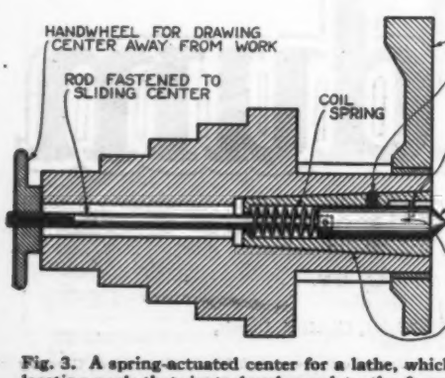
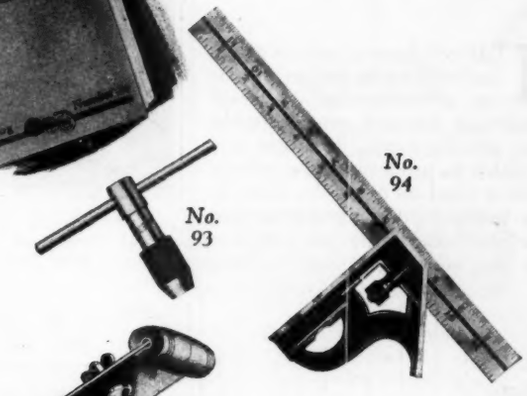
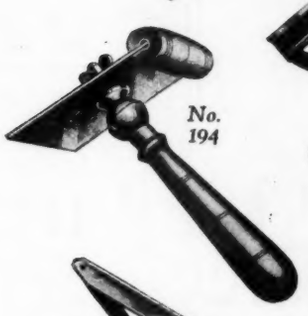

HANDWHEEL FOR DRAWING CENTER AWAY FROM WORK
ROD FASTENED TO SLIDING CENTER
COIL SPRING
FACEPLATE
TAP FOR #10-32 SET SCREW FOR GRINDING POINT
SLOT COLLET AND INSERT PIN IN CENTER
GRIND IN LATHE BEFORE CASE-HARDENING
SLIDING CENTER (GRIND TO FIT IN COLLET)
COLLET FITTED TO LATHE SPINDLE

Fig. 3. A spring-actuated center for a lathe, which saves time in locating work that is to be clamped to the faceplate for boring

OTHER timesaving shop ideas are contained in the continuation of the Better Shop Methods Department, which you will find on pages 98, 108 and 110.





"I found it in my Starrett Catalog"

"Here's a combination square that's eight tools in one—a marking gage, rule, try-square, miter, depth gage, height gage, level and plumb—and it's only one of many real useful tools I've found in my Starrett Catalog."

Every man or boy who loves to do good work with good tools—whether it's carpentry, metal working, motor repairing or model building—needs his own copy of the Starrett Catalog No. 24 W illustrating and describing over 2500 high grade tools.

Write for your copy today. It's free.

Then ask your tool dealer to show you the Starrett Tools you need.

THE L. S. STARRETT CO.
World's Greatest Toolmakers
Manufacturers of Hacksaws Unexcelled
Steel Tapes—Standard for Accuracy
ATHOL, MASS., U. S. A.

1512

Use Starrett Tools

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Short Cuts *for* Machinists

A Simple Way to Use Gears for Indexing Work on the Grinder—Depth Gage for Lathe Drilling—Extension Tool Holder for Planer—Universal Joint for Floating Reamer—Other Shop Kinks

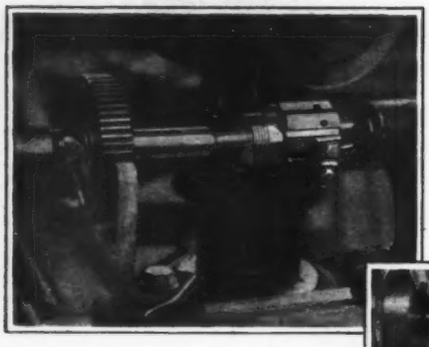


Fig. 1. A gear used on a grinder to index milling machine cutter heads

IT IS often necessary to grind indexed work, but as a rule no adequate or universal indexing fixtures are available for grinder work. It is not advisable to use a milling-machine index head on a grinder since it is likely to be injured sooner or later for accurate work on the miller. It is also much too heavy for convenience.

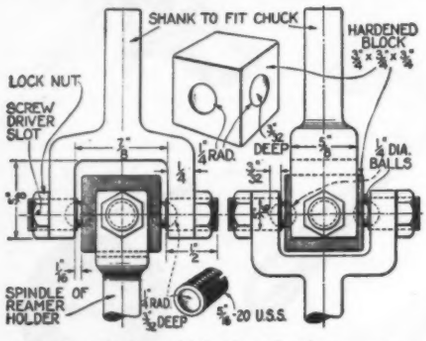


Fig. 6. A universal joint for a floating reamer; it is made of machinery steel, pack hardened

The simplest accurate method for universal indexing is to make use of change gears such as are supplied with universal millers and with engine lathes. With these practically any required division can be obtained. Figure 1 shows a case in hand. Several cutter heads for milling purposes were ground by using a gear for indexing and a spring finger to lock it in position.—O. S. MARSHALL.

WHEN drilling a job chucked in the lathe, such as, for instance, the one shown in Fig. 2, it is possible to rig a gage to indicate how far the drill has penetrated. A strip of sheet metal is secured to the drill chuck with a rubber band, and the end of the strip is lined up with the end of the drill and bent so that it just clears the work. The required depth of hole can be marked either on the gage strip or on the job itself. The idea might be carried further by using, instead of the sheet metal strip, a narrow steel rule, perhaps with a spring clip to hold it on the chuck.

When the job is of such shape that the gage strip will not pass over it while running, the strip can be bent down until it touches the drill, and set so that the end is exactly the depth of the hole from the point of the drill.

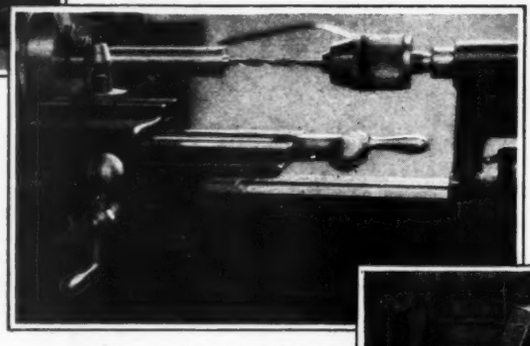


Fig. 2. A strip of sheet metal and a rubber band form this drilling gage

In practice this plan has been found quicker and simpler than putting a clamp, a tube, or a clip on the drill.—HOWARD GREENE.

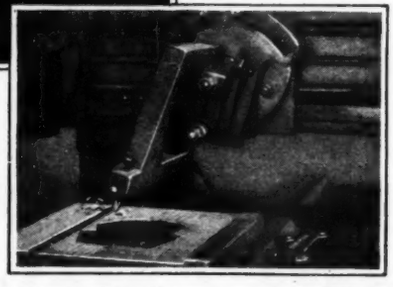


Fig. 3. Extension tool holder for planing wide work

HOW to overcome the handicap of an old style planer with only a narrow opening between the housings is illustrated in Figs. 3 and 4. A tool holder was made as shown so that the full stroke of the planer does not have to be used. The inside of the tool holder was cut out with a torch to give ample room for bolting it in place.—A. SKINNER.

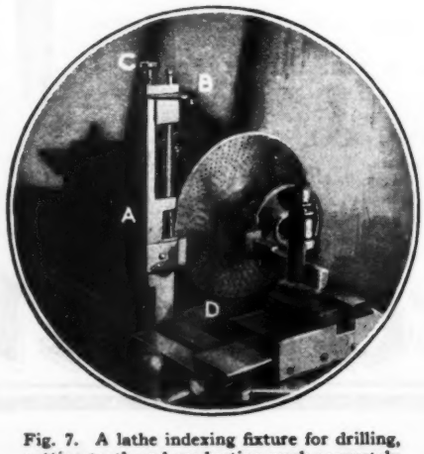


Fig. 7. A lathe indexing fixture for drilling, cutting teeth and graduating work accurately

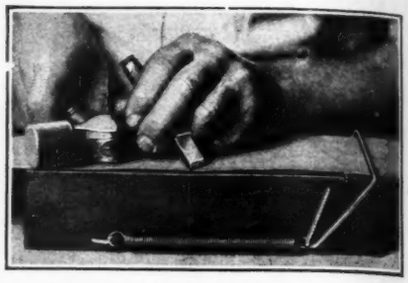


Fig. 5. A cutting block for sheet metal with a spring grip to hold down the thin stock

FIGURE 5 shows how a bench block was fitted with a spring grip arrangement to hold thin metal down at one end while it is being cut off with a chisel. Spring wire was bent as shown, the ends were sprung into a hole passing through the block near the top and suitable coil springs were attached.—H. M.

THE universal joint so widely used in machine construction is also practical for floating reamers. In Fig. 6 is illustrated a joint that is easily adjusted to take up wear. —H. J. C.

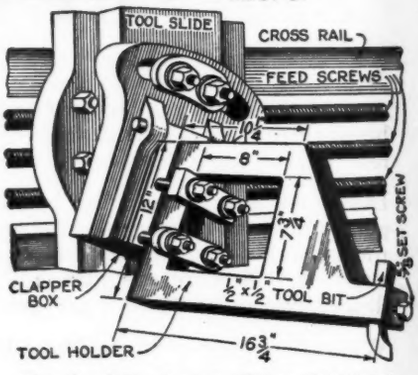
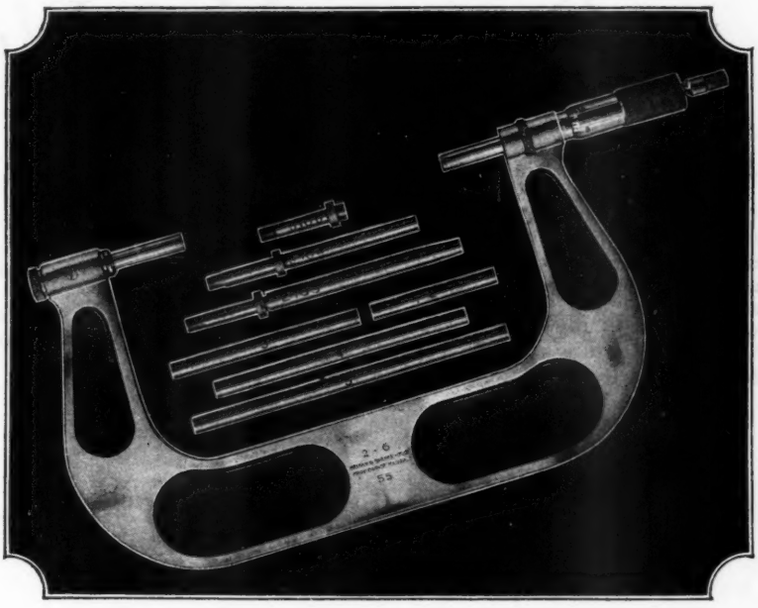


Fig. 4. How the extension tool holder is made. The large opening is cut with a torch

IN FIG. 7 is shown an indexing fixture for an engine lathe. A cast-iron or steel disk 10 or 12 in. in diameter is cut as a worm wheel on its periphery, preferably with 360 teeth. This is attached to the lathe spindle in place of the regular faceplate. A right-angle member *AD*, which is bolted to the bed of the lathe close to the headstock, supports a screw or worm, and at the upper end is an index plate *B*, and a crank and "flipper" pin *C*. This index plate, in conjunction with the large worm-wheel plate, provides for almost unlimited indexing operations.—O. M.

GOOD TOOLS ARE ESSENTIAL TO GOOD WORK



Micrometer Caliper No. 55 has a broad range of measurements, from 2″ to 6″, by thousandths of an inch. Range of measurements is easily obtained by four anvils, quickly changed and positively held in place by knurled nut.

Trained Hands Demand Fine Tools

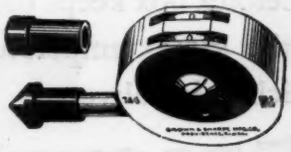
Mechanics prefer Brown & Sharpe tools because they know they can rely on their accuracy. These fine tools set a "world's standard of accuracy" and maintain this accuracy under hard usage.

These tools are on the job in thousands of shops where metal is worked, where all types of work depend on their reliability.

The Brown & Sharpe line of small tools includes over 5,000 items for both industrial and home workshop use. Catalog No. 30 describes them in detail. Copy at your hardware dealer's or sent free on request. Dept. P. S., Brown & Sharpe Mfg. Company, Providence, R. I., U. S. A.

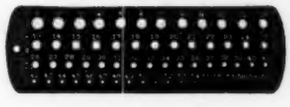
BROWN & SHARPE TOOLS ®

* MICROMETER CALIPER
Catalog No. 11



* VEST POCKET SPEED INDICATOR
Catalog No. 746

* DIAL TEST INDICATOR
Catalog No. 733



* TWIST DRILL AND STEEL WIRE GAUGE
Catalog No. 705

* RULE DEPTH GAUGE
Catalog No. 615

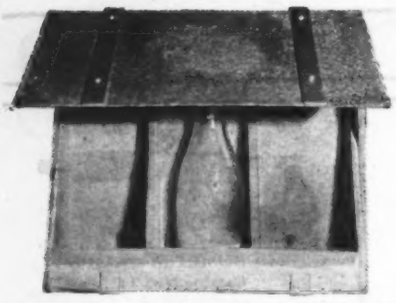
* AUTOMATIC CENTER PUNCH
Catalog No. 771

* IMPROVED UNIVERSAL BEVEL PROTRACTOR
Catalog No. 496

** This tool shown in Catalog No. 30*

B·S WORLD'S STANDARD OF ACCURACY

Ⓘ This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.



A Celotex box keeps the milk at the same temperature at which it is delivered.

CELOTEX
INSULATING LUMBER

Wherever used it gives
PROTECTION

Against heat, cold, noise and moisture.

Light to handle, easy to saw, nice to work with, decorative in appearance.

With Celotex
YOU *Can*

√ Line your attic
√ Cover cracked plaster
√ Ceil your basement
√ Make storm doors
√ Build bookshelves
√ Make a chest
√ Provide a table pad
√ Line your garage
√ Cut out book-ends
√ Build a playhouse

All Lumber Dealers Sell Celotex

Send coupon for publications that tell about Celotex

THE CELOTEX COMPANY, Chicago, Ill.

THE CELOTEX COMPANY
645 N. Michigan Avenue, Chicago, Ill.

Please send me
☐ The Home Improvement News (issued free each month).
☐ Interesting Things to Make with Celotex.
☐ The Celotex Building Book.
☐ 20 Places Where Celotex Saves in Industry.

Name.....

Address.....

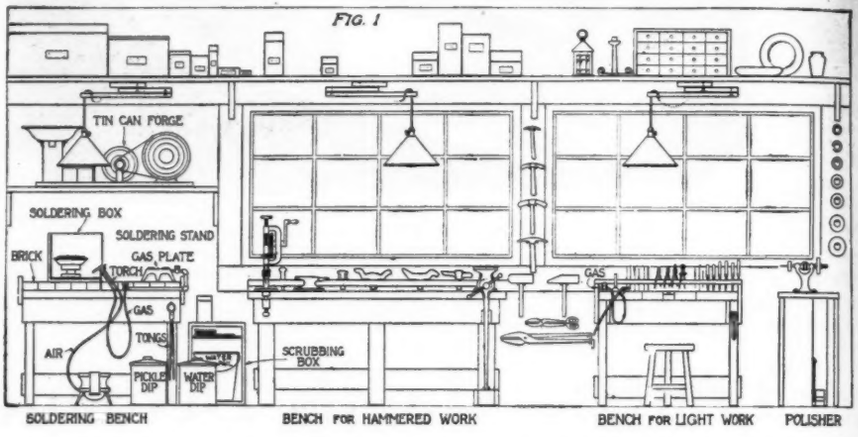
City..... State.....

How to Lay Out Your Shop for *Decorative* Metal Work

By EDWARD THATCHER

THE individual craftsman who takes up decorative metal work will, of course, adapt his shop layout to the space available, be it large or small. He may use benches and other equipment already in his possession provided they are in a good light. If there is only one window facing north, the best place should be given to the jeweler's or light work bench where one works seated.

FIG. 1



An ideal layout for a home workshop to be devoted to craftwork in metal. The units may be rearranged to suit the floor space, but in any case the small bench should be under a window

A layout such as the one shown in Fig. 1, where the benches are all along one wall, makes for convenience when transferring the work from one bench to another.

Plenty of closet and shelf room is needed. A small case filled with sliding drawers, such as the one shown above the bench for light work, is convenient for storing rivets, screws, drills and the like. Supplies such as lump or powdered pumice, charcoal, pitch, rosin and chemicals are best kept in labeled boxes. It is also a good plan to make a rack of some sort for sheet copper and brass. The high, narrow boxes used for glass by glaziers form excellent racks for flat sheet copper.

On the extreme left of Fig. 1 will be noted the soldering bench, the top covered with a layer of brick. On this bench stands the soldering box, in which rests the soldering stand or turntable.

Near by is the blowtorch, held by a special hook fastened to the bench. From the blowtorch runs a rubber hose to the foot bellows for the air supply; the other hose goes to a cock on the gas line. A pair of tongs hangs on a nail near the blowtorch for use in handling hot work.

The pickle and water crocks rest on the floor. A small gas plate is available for heating pickle, drying out work for hard soldering, and even for certain soldering operations.

The arrangement of this bench would be practically the same if a gasoline blowtorch were used.

A friend of mine utilizes an old kitchen stove for a soldering bench, the large flat iron top making an excellent place for soldering operations. The top of a sheet steel oil stove could be used in the same way after the stove had outlived its usefulness in the kitchen.

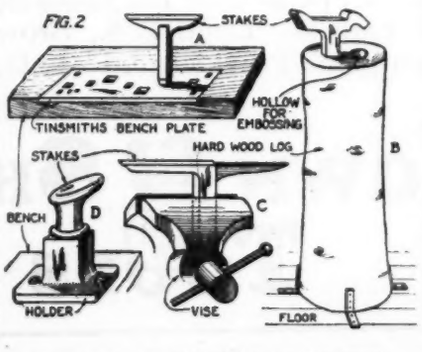
ON A shelf above the soldering bench is a forge for light work. It is set down on the bench for supplementing the heat of the blowtorch when soldering or annealing large work or melting metal.

The bench for hammered work should be constructed very solidly. Although suitable dimensions were suggested in another illustration of the bench published in the first article of this series (November, 1927, issue), the width and length should be made to suit the space available. The height of the top of the bench from the floor should be so planned that when a stake is in the vise you may do hammered work in a natural position.

Generally, the top of the vise jaws should be on a level with the elbow or slightly below it. A bench top from 28 to 30 in. from the floor will usually give this height, depending on the

(Continued on page 122)

FIG. 2



Four ways to hold stakes for hammered work. That shown at B is the least noisy

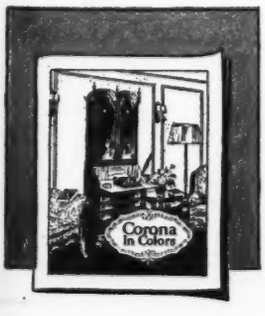
This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

CORONA IN *colors!*

[Channel blue]

CORONA has caught the colorful spirit of modern times! Scarlet, blue, green, maroon, cream, lavender—there is a Corona for every decorative scheme. (And, of course, the standard black Corona.) When you buy Corona, you know you are getting the utmost value in portable typewriters—the only portable with a twenty-year record of satisfactory performance. More Coronas are in use than all other makes of portables combined. See these new colored Coronas at the nearest Corona store. Convenient payment plan.

Write us for a free copy of this new folder showing the new Duco finish Coronas in actual colors.



L C Smith—the Ball-Bearing Office Machine. Its light touch and easy action increase output, eliminate fatigue.

L C Smith & Corona Typewriters Inc
Established 1903

Sales offices in principal cities of the world
313 E. Washington Street, Syracuse, N.Y.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

To the man who thinks he can't afford oil heat

A man's consideration for his family is not always measured by what he is able to do for them. Often the man with a moderate income is willing to make greater sacrifices to give his family the comforts of life than the man of unlimited wealth.

There are scores of thoughtful men who fully appreciate what Nokol automatic oil heat would mean to their wives and families—but whose ideas of the installation expense were obtained years ago, when oil heat was generally considered a luxury attainable only by the wealthy few.

Now quantity production and a new factory have enabled the American Nokol Company—oldest and soundest automatic oil burner manufacturer in the world—to produce a *fine* small burner for cottage or bungalow at a very low price.

A small down payment puts Nokol in your home—ready to operate. Mail the coupon for detailed information.

NEW *Silent* NO COAL NOKOL

REG. U.S. PAT. OFF.

AUTOMATIC OIL HEATING FOR HOMES

FREE—NEW BOOK

AMERICAN NOKOL COMPANY
4206 Schubert Ave., Chicago

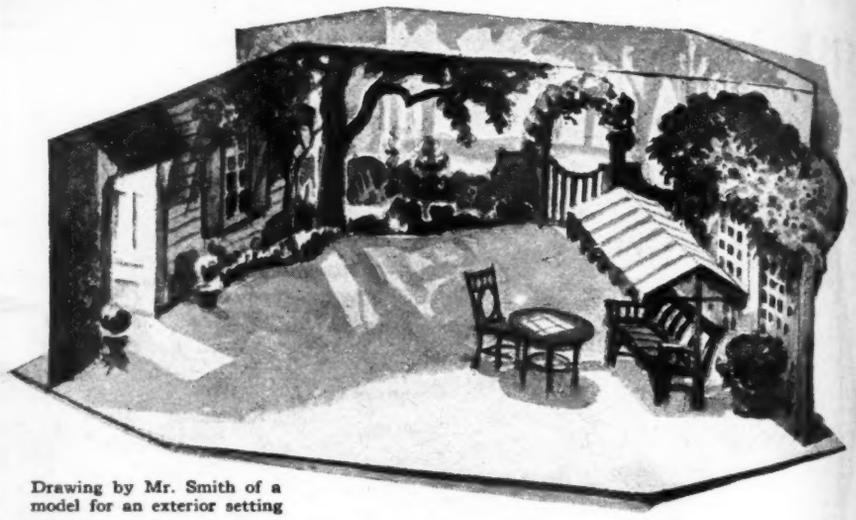
Please send me your new book on oil heat and details of your budget plan.

Name .....

Address .....

City ..... State .....

Oldest and soundest automatic oil burner manufacturer in the world



Drawing by Mr. Smith of a model for an exterior setting

SCENECRAFT—The Exterior Set

How to Interpret the Playwright's Script—Sketches and Models—Hints on Painting and Lighting

By ANDRE SMITH
Author of "The Scenewright"

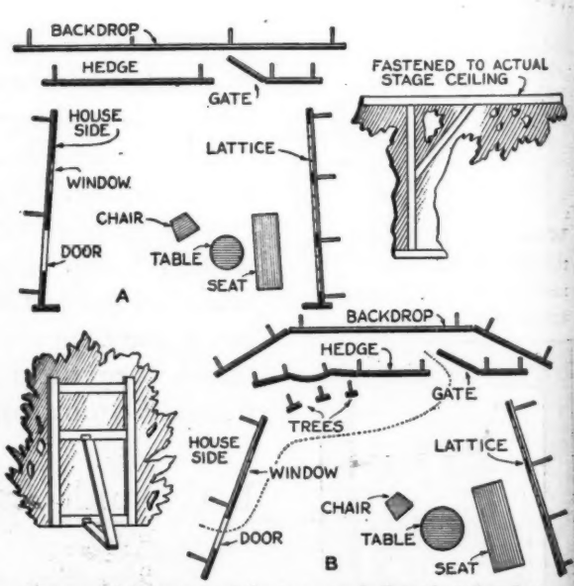
IN THE designing and building of an exterior setting the amateur scenewright finds himself up against a more difficult problem than any he has encountered in his experience with interiors. He knows well enough that he can create three walls of a room, but he stands in awe of the wall-less outside, where tree forms, flowers and atmosphere are perhaps the only limits to his set.

The problem, after all, is not so difficult as it seems. In the interior set the scenewright shuts off his back- and side-stage areas with three obvious walls, and in the exterior set he does the same, with this difference: the walls are *not obvious*.

In its crudest conception an exterior set consists of a back wall in the form of a painted back drop, and side walls in the shape of painted flats. As far as the exterior set is concerned it still remains, in spite of the healthy changes in the modern method of scene building, a matter of paint and illusion. Amateur play producers who have organized merely with the idea of giving one play, and who have to build their settings with as little fuss and expense as possible, can have no great curtain of blue canvas (cyclorama) to encircle the stage. Whatever bit of heavenly blue enters their setting will have to be done in paint on a back drop, and the actual stage ceiling or a painted blue lid will have to take the place of the infinite spaces of the sky. It is too bad, but it can't be helped. And so, facing our enforced limitations, let us tackle our problem with a stout heart and do the best we can.

In order to see how the thing is done let us set for ourselves an actual problem in scene designing. Let us suppose that the playwright's script reads as follows:

ACT TWO: The garden in the Bradley home. It is one of those simple New England back-yard gardens, the kind that seems to be self-created, in which flowers happen as if by chance rather than by some skillful gardener's direction. The wall of the Bradley house occupies the right of the stage. It is a rear wing of the house and contains an entrance door and a window. Over the door is a simple shed roof supported (*Continued on page 124*)



The essential elements of the scene are indicated at *A* and an improved arrangement at *B*. Two tree forms are also shown

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Make Your Home a Pleasant Place to Live In

An old bureau beautified with KYANIZE Celoid Finish and KYANIZE Decals —Junetime design.
A time-worn cabinet made attractive with Celoid and KYANIZE Decals—Balkan design.
You can make your lamp shades, too, in this easy way —KYANIZE Celoid Finish and KYANIZE Decals —Cameo design.

Kyanize

The Easy-to-Use Finishes

WITHOUT hard work or special expense, KYANIZE Varnishes and Enamels add beauty, charm and value to woodwork, furniture, floors and walls.

KYANIZE Celoid Finish is a medium gloss waterproof enamel in white and many dainty tints and will make an attractive set of furniture out of shabby old pieces that are now mismates. This finish is an opaque, medium gloss enamel, free from offensive odor. It brushes on easily, dries quickly enough to prevent brush marks, and leaves a rich, velvet-like, "hand-rubbed" effect—sturdy, elastic and waterproof. Even old black walnut or dingy oak hide their gloomy surfaces behind one or two coats of KYANIZE Celoid Finish. Ideal also for tinting woodwork and walls. Comes in twelve delightful tints—and you yourself can mix a wide variety of additional hues with ease.

KYANIZE Floor Enamel is the all-around floor coating. It is equally effective indoors and out, on stone, cement, concrete, wood or old pattern-worn linoleum. No matter how badly worn, scratched, scarred or stained an old floor happens to be, overnight you can transform it into a new, permanently bright, spotless area—proof against water, weather, wear—even the corroding effects of acid. Nine solid colors enable you not only to paint old floors but to decorate them as well in varying patterns. Excellent, too, for porch, lawn and garden furniture; farm wagons, gear and implements.

KYANIZE Decal Transfers—fully described in our book, "The Charm of Painted Things," add the final touch of beauty to articles refinished with KYANIZE. These exquisite floral and silhouette decorations can be applied in a minute or two, and they are as amazing in results as they are simple in application.

BOSTON VARNISH COMPANY
36 Everett Station, Boston, Mass., U.S.A.

BOSTON VARNISH COMPANY, 36 Everett Station, Boston, Mass.
Enclosed is ten cents for your Booklet, "The Charm of Painted Things." Illustrated beautifully in colors and containing many finishing suggestions.

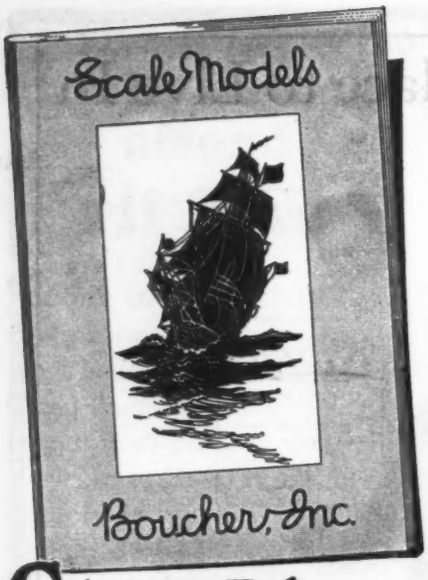
Name.....

Address.....

.....

Kyanize

VARNISHES & ENAMELS *for Floors-Furniture-Woodwork*



Ship Plans

Ancient and Modern

THE plans for the ship models listed below are the result of years of Mr. Boucher's personal effort and study of Marine Models. For 23 years, since 1905, he has conducted his Model Shop where practically all the Marine Models made in the United States have been turned out.

Boucher, Inc., has been commissioned to build models, where the greatest care and craftsmanship were prime requirements, for the U. S. Navy Department, the U. S. War Department, the U. S. Shipping Board, the National Museum, Carnegie Institute, Foreign Governments, Yacht Clubs and Steamship Companies. You are assured of the same care and exactness in Boucher Plans that are found in finished models made by this Company.

You can buy the model plans of the ships listed below and be sure they are as clear, thorough and accurate as possible. Let us know the plan or plans you are interested in and we will send you full information. Also it will pay you many times over to have the encyclopedic-catalog "Scale Models."

Special New Plans

		Model Size Over All	Period
Isaac Webb	185-ft. Packet Ship	18 inches	1850
Rainbow	159-ft. Clipper Ship	19 inches	1841
Helena	135-ft. Clipper Ship	18 inches	1841
Naval Vessels			
Alfred	24—Gun Ship (First American Flagship)	15 inches	1775
Ohio	74—Gun	20 inches	1820
Monitor	Single Turret Ship	22 inches	1862
Merrimac	Iron Clad Steamer	33 inches	1862
Oregon	Battleship	42 inches	1890
Battle Cruiser	Typical	26 inches	Modern
Merchant and Historic Vessels			
Flying Cloud	225-ft. Clipper Ship	28 inches	1851
Smuggler	Gloucester Schooner	20 inches	1877
America	Schooner Yacht	25 inches	1851
Half Moon	Hendrick Hudson's Ship	19 inches	1609

And there are dozens of others listed in the Catalog

Send for Booklet "Scale Models"

This booklet—SCALE MODELS—has 92 pages of useful information for model makers. Contains history of steam engines, nautical terms, knots, hitches and splices commonly used on boats. Recommendations for finishing and painting model ships and hundreds of other ideas.

Whatever type of ship—sail or steam—ancient or modern—you are building, or planning to build, you will find the booklet, SCALE MODELS, of tremendous help. Send 25c today for your beautifully illustrated copy. It will be sent you by return mail, postage prepaid.

Gentlemen:—Enclosed is 25c for which please send me immediately your 92-page illustrated booklet, SCALE MODELS.

Name.....

Address.....

Headquarters for Model Makers for 23 Years

Boucher Inc

415 Madison Ave. Dept. MM N. Y.

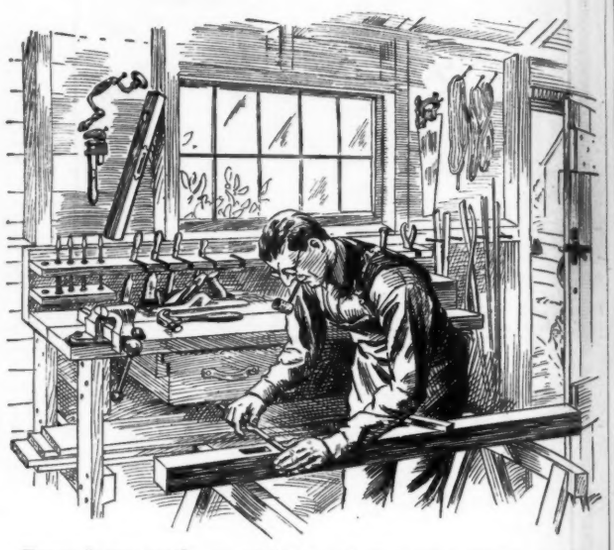
Tools — Pride of My Farm

They Save Time and Money in Making Essential Repairs—My First Outfit and How I Added to It

By GARFIELD MACDONALD

WE FARMERS are confronted with a difficult problem in selecting tools for our workshops. In the first place, most of us have not the time to spend in building things purely for pleasure; we build from necessity. In the second place, we are called upon to make many makeshift repairs on our implements and machines until parts come from the factory.

When I purchased my farm it was supposed to be fully equipped. Well, it did have all the farming implements ready for action, but the tools consisted of a few rusty wrenches, a saw, and a low grade hammer with one claw broken.



Every farmer needs an assortment of good tools because of the variety of work he has to do in repairing implements and machines

I purchased a few tools from time to time, being guided in large part by the lists of home workshop tools published in POPULAR SCIENCE MONTHLY some time ago. Now I have a complete set of tools which, besides being the means of saving me money, are my pride and joy.

My first outfit is ample for the beginner and serves as the nucleus for the second and third outfits so that the farmer can add to it from time to time until he has a complete set of tools. It is as follows:

- Spirit level, 24 in.
- Rule, 2 ft., threefold
- Bell-faced hammer
- Ratchet bit brace
- Bits, ¼, ½, ⅝, 1 in.
- Iron jack plane
- Hand saw, 24 in., 8 points (crosscut)
- Chisels, ½, ¾, 1 in.
- Screw driver
- Try-square, combination type
- Pin punch
- Pipe wrench, 12 in.
- Saw file, 6 in.
- Flat file, 8 in.
- Fence tool
- Shingling hatchet
- Cold chisel, ½ in.
- Harness stitcher and repair outfit
- Pliers, wire cutting
- Oilstone

This set is inexpensive and in the hands of a man with a slight liking for repair work will serve for an astonishing variety of jobs. For the second set my choice comprises all the first set and the following tools:

- Leather punch, 6 bits
- S-handled adjustable wrench, 8 in.
- Taper saw files, ½ doz., assorted
- Flat files, ½ doz., assorted
- Half-round wood rasps, 3, assorted
- Hand file for reaper blades
- Breast drill, ratchet
- Oil can
- Draw knife, 10 in.
- Screw driver bit
- Bits to complete set from 3/16 to 1 in. by 16ths
- Machinist's hammer, 1¼ lb.
- Block plane, lever adjustment
- Glass cutter
- Soldering outfit
- Steel square, 2 ft.
- Round shank drills, 1/16 to 5/8 in.
- Sharp nose pliers
- Pistol grip hack saw
- Hack saw blades, 12, assorted lengths
- Tool grinder
- Saw set
- T-bevel
- Tack hammer
- Vise, 5-in. jaws
- Compass saw, 12 in.
- Hand saw, 20 in., 8 or 9 points
- Rip saw, 26 in., 6 points

With this set a farmer can make difficult repairs on machinery, erect buildings, and do countless repair jobs. While this is a representative assortment, it is not supposed that the list will be adhered to strictly; it may be modified to suit any special needs.

The third set consists of tools of the first and second sets with the addition of the following. The forge enables a man to make even difficult metal repairs on machinery.

- Miter box
- Tape line, 100 ft.
- Rose countersink
- Smooth plane
- Blowtorch
- Carpenter's pincers
- Expansion bit
- Cold chisels, ½ doz., assorted
- Hand drill and set of bits
- Chisels, ⅜, 1½, 2 in.
- Button's pattern pliers
- Tap and die set, ¼, 5/16, ⅜, 7/16, ½, 5/8 in.
- Forge, 22-in. hearth
- Anvil, 75 lbs.
- Horse rasps, 2
- Farrier's hammer
- Blacksmith's hammer, 2½ lbs.
- Bolt tongs
- Straight lip tongs
- Blacksmith's pincers, 12 in.
- Farrier's knife
- Mortise gage
- Spokeshave
- Floor scraper
- Tin snips
- Chain hoist
- Socket wrench set
- Valve grinder and paste
- Hydrometer
- Five-minute vulcanizer

I always have on hand in the shop a good stock of hard and soft wood, strap and bar iron, nuts, bolts and washers, glue, rivets, screws and nails, belt lacing and harness leather.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Taking the Pulse of a Gigantic Artery of Water ~

Down from huge reservoirs in the hills, a mighty torrent of water comes rushing through the great main to give a city its water supply. Like the pulse of a great artery, the venturimeter faithfully measures and records the passage of every gallon.

In order that this ingenious mechanism may render a true account of the thousands of gallons of water rushing through the huge underground tubes, its recording cam must have a surface that is absolutely even and smooth. It is with a NICHOLSON File that this all important surface is obtained. The choice of a NICHOLSON File for this operation emphasizes the fitness of our tools in work where accuracy and fineness count.

Our booklet, "Adventures and Uses of NICHOLSON Files" will be sent to you if you are interested in what our files are doing.

NICHOLSON U.S.A. (TRADE MARK)

NICHOLSON FILE CO. Ⓢ
Providence, R. I., U. S. A.

— A FILE FOR EVERY PURPOSE

Ⓢ This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Pipe Lover Finally Discovers Tobacco Satisfaction

Everlastingly trying brings success, even in finding the right tobacco. Mr. Gaw's experiences prove that. He tried more than ten different brands of smoking tobacco, paid high prices, only to suffer the pangs of dissatisfaction. Finally he concentrated on Edgeworth, and it was then that he achieved true pipe-enjoyment. Read what he says about it:

Philadelphia, Pa.
Sept. 21, 1927

Larus & Bro. Co.
Richmond, Va.
Gentlemen:

I write you this complimentary letter because I feel that if any one tobacco company deserves praise for its products, it is your company.

During the two years that I have been a pipe smoker I have used more than one—in fact more than ten—different tobaccos. I have even invested as much as one dollar and twenty-five cents for a half pound of a well-known mixture, trying to find satisfaction in price; but it was all in vain. After the first few pipe-loads I readily discovered that even price and a reputation couldn't supply that bit of satisfaction that my pipe and myself crave.

I had no other choice, so it seems, but to return to the most satisfactory pipe tobacco that I have ever experienced. That tobacco is none other than the Edgeworth tobacco.

Now the pangs of dissatisfaction and grief over exorbitant prices have entirely disappeared since I've concentrated my pipe smoking on Edgeworth.

I am taking this means of thanking you for curing my pipe ills as well as putting my mind at ease now that I have tobacco that satisfies pipe as well as man.

Your ardent well-wisher,
Samuel Gaw

There seem to be a lot of men who have an unsatisfied smoke-yearning. But those who persevere until they discover Edgeworth seem to be so satisfied that they want to tell the whole wide world about its goodness.

To those who have never tried Edgeworth, we make this offer:

Let us send you free samples of Edgeworth so that you may put it to the pipe test. If you like the samples, you'll like Edgeworth wherever and whenever you buy it, for it never changes in quality.

Write your name and address to Larus & Brother Company, 10 S. 21st Street, Richmond, Va.

Edgeworth is sold in various sizes to suit the needs and means of all purchasers. Both Edgeworth Plug Slice and Edgeworth Ready-Rubbed are packed in small, pocket-size packages, in handsome humidors holding a pound, and also in several handy in-between sizes.

[*On your radio—tune in on WRVA, Richmond, Va.—the Edgeworth Station. Wave length 254.1 meters. Frequency 1180 kilocycles.*]

Wood Turning Simplified

Choosing a Lathe—Spindle Speeds—How to Sharpen Gouges and Chisels

By HERMAN HJORTH

Fig. 1. Thumb-nail test for a chisel; if it "takes hold," it is really sharp

IF YOU have a hobby, you may consider yourself fortunate in this age of speed and mental strain. An interesting hobby takes the mind off business problems, gives it a rest and tends to keep it healthy and normal. Modern psychologists, medical practitioners and educators stress the value and importance of developing a hobby; indeed, it is one of the frankly avowed aims of manual arts instruction in the schools of today.

An ever-increasing number of men find relaxation in their home workshops. If you are one of them, you can add greatly to your enjoyment and at the same time improve your craft work in quality and variety by learning how to do wood turning. And this is not hard to do, especially now that such excellent motor-driven lathes are available at reasonable prices.

There is an unescapable fascination about wood turning. The shapes seem to form by magic under one's gouge and chisel. Perhaps that is why kings and princes and even queens and ladies of high rank amused themselves by practicing wood turning during the seventeenth century. Examples of their handwork are to be found in many European museums.

Simple as wood turning is, the beginner will make much faster progress if he takes the pains to observe the suggestions which will be given in this and following articles.

As a result of many years of teaching experience, the author will explain something that is really a great deal easier than conventional wood turning. It is what might be called "wood scraping." This can be mastered more quickly and, generally speaking, is more accurate than orthodox wood turning. While it is not quite so fast, this is a matter of small importance from the standpoint of the amateur. Almost anyone can do scraping at once without the many discouraging and disheartening slips of the tool and consequent spoilage of work so characteristic of wood turning practice.

Fig. 2. The edges of scraping tools are sometimes turned over with a burnisher to form a burr or hook

Those who have learned or taught wood turning in the generally accepted way may disapprove of this method. In its justification, however, it may be stated that pattern makers do all turned work on wooden patterns by means of scraping. If the method is effective in such accurate work, why is it not equally useful in producing turned parts for other purposes? Many manual training teachers will permit scraping in difficult places and on what is called faceplate work. Why not then be frank

(*Continued on page 100*)

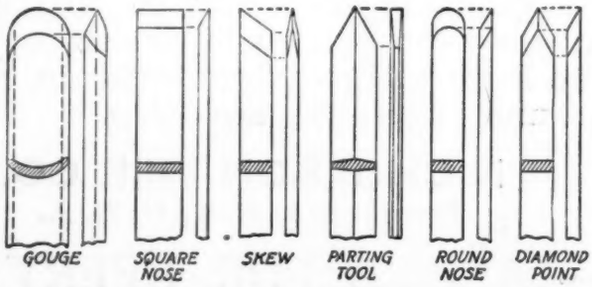


Fig. 3. A set of turning tools for the beginner. They must be supplemented by calipers, dividers, rule, oilstone and slip stone

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

"D. Maydole"

—a name that carpenters, machinists, men who know and love fine tools the world over recognize instantly as the standard of honest quality and enduring value.

There is a style and weight Maydole for every purpose. Heads are press-forged of selected tool steel. Handles are of clear, second-growth, air-dried hickory put on "for keeps." And every one has that marvelous Maydole "hang."

Your dealer will gladly show you the genuine Maydole. Look for the "D. Maydole" on the head.

Write us for free copy of interesting and useful Pocket Handbook 23 "B."

YOUR HAMMER SINCE 1843

Maydole Hammers

The David Maydole Hammer Co., Norwich, N.Y.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

New Model

Pocket Ben

You can be on time if you have a sturdy, reliable watch.

The new model Pocket Ben is that sort. And he's mighty good-looking, too—a favorite among busy men.

Sold everywhere for $1.50. With night-and-day dial, $2.25

Built by the makers of Big Ben and other Westclox

WESTERN CLOCK COMPANY
La Salle, Illinois

New Auto Clock

Attractive, convenient, reliable. Fits any car. Quickly attached on dash or above wind-shield. Price $2.50.

$2.50

Wood Turning Simplified

(Continued from page 98)

about it and teach a method that will give the most pleasure and profit to the learner?

It is with this need in view that the following instructions, which have been tried out in actual school work, are given. The procedure is the same whatever the size of the lathe and whether you are turning a candlestick on a small motorized home workshop outfit or a table leg on a larger lathe such as that shown in Fig. 5, below. Note well the names of the various parts, for they will be mentioned repeatedly in this and following articles.

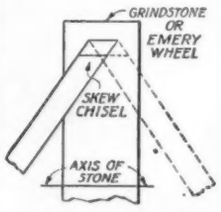


Fig. 4. A skew chisel is ground angularly

Selecting a lathe depends, of course, on several factors, such as the type of work to be done, the space available and the price. The majority of the many small lathes now on the market suitable for home work are equipped with attachments for sawing, boring, grinding, buffing, sanding and the like. A surprising amount of work can be done on such an outfit.

For general woodworking and furniture making, it is well to select a lathe that is at least 30 in. long between centers—the standard length of a table leg—and has a swing of at least 9 in. The height of the lathe center over the bed indicates the swing; that is the diameter of the stock which can be turned. If it is 6 in. above the bed, the lathe has a 12-in. swing. Lathe beds of extra length can usually be obtained at a slight additional cost.

A motor-head lathe, that is, one with a variable speed motor mounted directly on the headstock, is the most convenient to use and takes up the least space. The more common type of lathe shown in Fig. 5 is driven by means of a cone pulley belted to a countershaft, which has a similar cone pulley and also a tight and loose pulley. The countershaft is generally fastened to the ceiling beams above the lathe. A small motor drives the countershaft and this in turn drives the lathe. By means of a belt-shifting device, generally consisting of an iron fork to which a wooden handle is fastened, the belt is moved from the loose to the tight pulley when it is desired

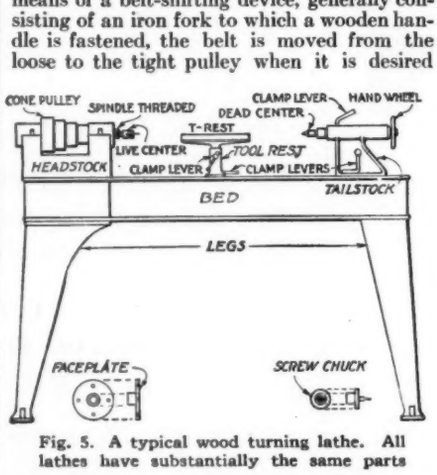


Fig. 5. A typical wood turning lathe. All lathes have substantially the same parts

to start the lathe. Sometimes a special motor is furnished with the lathe and is fastened to the legs below the headstock.

A lathe should run at a speed of about 2500 revolutions a minute when the belt is on the smallest step of the cone pulley. If it is necessary to buy new pulleys when installing a lathe, their diameters can be easily calculated if it is remembered that the diameter of the driven pulley times the number of revolutions it makes is always equal to the diameter of the driving pulley times the number of revolutions it makes.

Suppose we buy a lathe with its corresponding countershaft and the cone pulleys have three steps, the smallest being 3 in. in diameter and the largest 9 in. The tight and loose pulleys measure 6 in. in diameter. We have a ¼-H. P. motor with a speed of 1200 revolutions a minute. The motor is equipped with a pulley 4 in. in diameter. Will this motor drive the lathe at the proper speed?

IT IS first necessary to find the speed at which the countershaft will revolve when it is belted to the motor.

The revolutions of the motor multiplied by the diameter of the pulley equal the revolutions of the countershaft multiplied by the diameter of the loose pulley.

1200 x 4 = rev. of countershaft x 6
4800 = 800 x 6
4800 = 4800

The countershaft makes 800 R.P.M., therefore the cone pulley on the countershaft also makes 800 R.P.M. The problem now is to find how many revolutions the lathe spindle makes.

The revolutions of the countershaft multiplied by the diameter of the large cone pulley equal the revolutions of the live spindle multiplied by the diameter of the small cone pulley.

800 x 9 = rev. of live spindle x 3
7200 = 2400 x 3
7200 = 7200

Stock not more than 3 in. in diameter can be turned at the highest speed of the lathe (2500 R.P.M.); stock from 3 in. to 6 in. in diameter should be turned at a medium speed with the belt on the second step of the cone pulley, and stock over 6 in. in diameter should be turned at the slowest speed of the lathe.

Before the stock is rounded off and runs true in the lathe, it causes a good deal of vibration. The lathe should, therefore, be run at a lower speed until this process has been completed, as excessive vibration may cause the stock to be thrown violently from the lathe.

For the first lathe work, the following tools (see Fig. 3) are sufficient: 1-in. gouge, ¾-in. square-nose chisel, ½-in. skew chisel, ⅛-in. parting tool, ½-in. round-nose chisel, ½-in. diamond-point chisel, 6-in. outside spring caliper, 6-in. inside spring caliper, 8-in. wing dividers, rule, oilstone and slip stone.

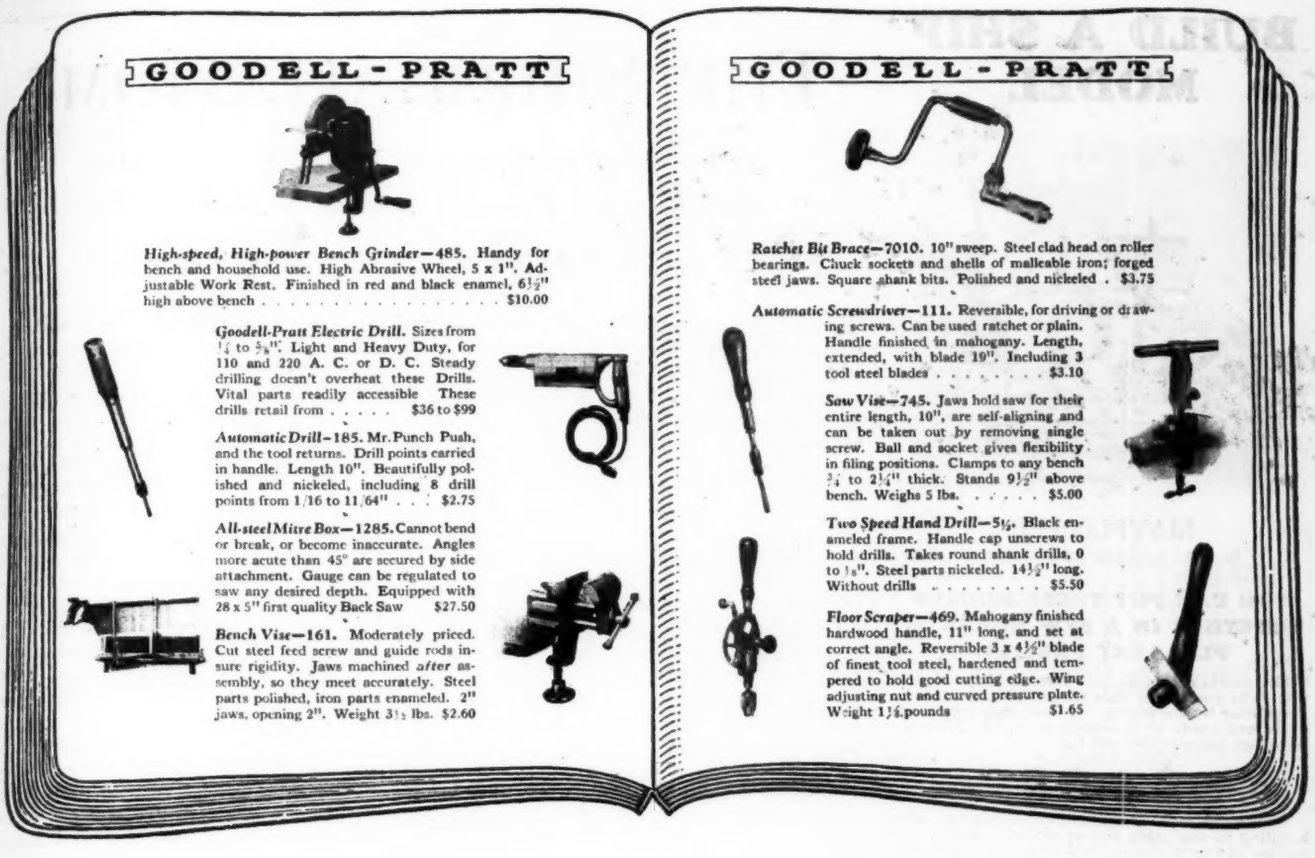
THE gouge is ground to semicircular shape with the bevel extending well around to the sides so as to leave no sharp corners as on the carpenter's gouge. The bevel should be about twice as long as the gouge is thick. It is ground on a sandstone or an emery wheel. If no water or kerosene runs over the stone, care should be taken to dip the tool frequently during the grinding process to prevent overheating and drawing the temper of the steel.

Grasp the handle with the right hand, hold the blade to the surface of the stone with the left hand and move the gouge across the face of the stone with a rolling motion.

When ground, the gouge is whetted on an oilstone. The bevel is brought in contact with the stone and the gouge moved back and forth and simultaneously rolled from one side to the other. The wire edge, which is bent towards the inside by this process, is removed by rubbing the rounded edge of a slip stone back and forth over it. Keep the whole edge of the slip stone in contact with the inside of the gouge during this operation.

While the square-nose turning chisel is longer than an ordinary chisel, any common chisel can be used in place of it if it has a long blade and is fairly *(Continued on page 114)*

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.


GOODELL-PRATT
High-speed, High-power Bench Grinder—485. Handy for bench and household use. High Abrasive Wheel, 5 x 1". Adjustable Work Rest. Finished in red and black enamel, 6½" high above bench $10.00
Goodell-Pratt Electric Drill. Sizes from ¼ to ⅝". Light and Heavy Duty, for 110 and 220 A. C. or D. C. Steady drilling doesn't overheat these Drills. Vital parts readily accessible These drills retail from . . . . . $36 to $99
Automatic Drill—185. Mr. Punch Push, and the tool returns. Drill points carried in handle. Length 10". Beautifully polished and nickeled, including 8 drill points from 1/16 to 11/64" . . . $2.75
All-steel Mitre Box—1285. Cannot bend or break, or become inaccurate. Angles more acute than 45° are secured by side attachment. Gauge can be regulated to saw any desired depth. Equipped with 28 x 5" first quality Back Saw $27.50
Bench Vise—161. Moderately priced. Cut steel feed screw and guide rods insure rigidity. Jaws machined after assembly, so they meet accurately. Steel parts polished, iron parts enameled. 2" jaws, opening 2". Weight 3½ lbs. $2.60
GOODELL-PRATT
Ratchet Bit Brace—7010. 10" sweep. Steel clad head on roller bearings. Chuck sockets and shells of malleable iron; forged steel jaws. Square shank bits. Polished and nickeled . $3.75
Automatic Screwdriver—111. Reversible, for driving or drawing screws. Can be used ratchet or plain. Handle finished in mahogany. Length, extended, with blade 19". Including 3 tool steel blades $3.10
Saw Vise—745. Jaws hold saw for their entire length, 10", are self-aligning and can be taken out by removing single screw. Ball and socket gives flexibility in filing positions. Clamps to any bench ¾ to 2¼" thick. Stands 9½" above bench. Weighs 5 lbs. $5.00
Two Speed Hand Drill—5½. Black enameled frame. Handle cap unscrews to hold drills. Takes round shank drills, 0 to ⅛". Steel parts nickeled. 14½" long. Without drills $5.50
Floor Scraper—469. Mahogany finished hardwood handle, 11" long, and set at correct angle. Reversible 3 x 4½" blade of finest tool steel, hardened and tempered to hold good cutting edge. Wing adjusting nut and curved pressure plate. Weight 1¼ pounds $1.65

THE ten carpentry tools pictured here are single examples of the sizes in which each is made. The catalog also features all kinds of tools for machinists, and professional and amateur mechanics.

400 pages of fine tools *FREE*

Select your tools from this catalog—then buy them from your hardware dealer, mill supply or automotive supply dealer

THIS 400-page catalog is used by carpenters, mechanics, and machinists—who select from its pages the tools they need—and buy them through their local hardware or mill supply man.

You, too, will find this a pleasant and easy way to buy tools. A three-page index helps you find what you want—at once. Clear, easily understood descriptions and good pictures leave nothing for you to guess at.

Whether you make your living with tools or use them to follow a hobby, you need this booklet, with its 400 pages of pictures and information.

Goodell-Pratt Tools will serve you well for years. No finer tools are made than those that bear the name of Goodell-Pratt.

Select your needs from this catalog; then buy them from your nearest dealer. If he doesn't carry the Goodell-Pratt line, write us for the name of a dealer who can supply you.

For the catalog, address Ⓢ

GOODELL-PRATT COMPANY, GREENFIELD, MASS., U. S. A.

MAKERS OF Toolsmiths, MR. PUNCH

GOODELL-PRATT

1500 GOOD TOOLS

Ⓢ This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

BUILD A SHIP MODEL

MAYFLOWER

Size: 25" high; 26" long; 10" wide

YOU CAN PUT THESE MODELS TOGETHER IN A FEW HOURS OF PLEASANT PASTIME

The world's largest builders of ship models will help you build this model of the historic Mayflower by supplying all necessary parts cut to fit and ready to assemble with full instructions for assembling—all for

$4.98

You need not know anything about ship building to assemble one of these models. As a matter of fact if you have never seen a ship you can put the model of the Mayflower together in a few hours by following our diagrams and instruction sheet which is so written that a school boy can understand it. All you need is a small hammer. The parts are numbered on the diagram to make the process even more simple. As long as you can understand such instructions as these (actually taken from assembling chart that is included with every model of the Mayflower) you cannot fail: "Take No. 57, place it in front end of No. 56 and tap lightly with hammer. Next take No. 58 and place it up against No. 57 and tap with hammer to bring it into place."

Easy? Nothing simpler. The instructions are just like that from beginning to end. Do this and that—and before you realize it a beautiful model has grown before your eyes.

The model of the Mayflower is exact in every detail. After you have completed building one of our models from the $4.98 kit you will be so well satisfied that you would not take $50.00 or even $100.00 for the model.

Besides the model of the Mayflower we manufacture parts for other historic ships including the Santa Maria, La Pinta and Constitution (Old Ironsides). These ships (with the exception of Old Ironsides) may also be obtained with the melody sail (loud speaker) attachment. The Santa Maria and the Mayflower have been the most popular ship models ever built. We have sold these models to people in every part of the world and are shipping a large quantity of them daily to various parts of the United States, Europe, South America and even to Africa.

Send for our beautifully illustrated catalog which contains information and photographs of all our models.

All Goods Sold on a Money Back Guarantee

MINIATURE SHIP MODELS, Inc.

3824 Baring Street, Philadelphia, Pa.

MINIATURE SHIP MODELS, INC.,
3824 Baring St., Phila., Pa.

Please send me complete parts, cut to fit and ready to assemble for the Constitution, $6.98 ☐; Santa Maria, $4.98 ☐; La Pinta, $4.98, ☐; Mayflower, $4.98 ☐. Melody Ships: La Pinta, $12.50 ☐; Santa Maria, $12.50 ☐; Mayflower, $12.50 ☐. I will pay postman purchase price plus postage (a few cents).

Check which model you want shipped.

PLEASE PRINT NAME AND ADDRESS PLAINLY

Name .....

Street or R. F. D. .....

City .....

State .....

THE SHIPSHAPE HOME

How to Fill Cracks Around Bathroom and Kitchen Fixtures and in Plaster Walls

By F. N. VANDERWALKER

EVEN the most carefully constructed house will suffer a little from the settlement of the foundation. Some cracks will open in the walls and the joints in floors, wood trim and built-in plumbing and cabinet fixtures. Furthermore, the shrinkage of lumber opens up cracks in wood trim and in floors, such as those often seen about a fireplace and hearth of tile or brick. With the flight of time other defects become noticeable.

These defects may not be serious, but they constitute eyesores. No one likes to be confronted with a number of indications of wear and tear, yet how to have them taken care of is a problem. The jobs are too small for neighborhood tradesmen to be interested in; if they make such repairs at all, it is usually the result of repeated telephone calls and much bother.

Almost all such minor repairs can be done just as well by any person about the house as by a skilled mechanic, once the right material and a little information are at hand. Incidentally, there is considerable saving in both time and money, to say nothing about convenience, in doing the job yourself.

Plaster of Paris, patching plaster, and white lead putty are used to fill bathroom cracks

In this and following articles the necessary information for filling holes and cracks will be set down tersely. Materials, tools and methods will be described.

Bathroom Cracks

RECESS tubs, which are butted close to tile and plaster walls, sometimes pull away from the tile, leaving an unsightly crack. The settlement of the floor and the shrinkage of timbers in the wall are the usual causes.

To fill such cracks, the first step is to cut off all loose cement and sharp projections with a putty knife or screw driver. Be careful not to dig at the surface so hard that the vitreous coating on the tub or wall will be scratched or chipped.

If the crack extends down deeply between the tub and wall, any filling of putty will drop down out of sight. Consequently, this space must first be filled to within an inch or two of the top with strips or wads of newspaper.

There are a number of materials that can be used for filling such cracks. A dime's worth of plaster of Paris will do. Dump it into a clean can and cover completely with water. It will keep soft indefinitely as long as it is submerged. Take out a handful and knead it with your fingers until it becomes plastic like bread dough. Fill the crack with this putty, after first wetting the opening with water. Crowd the putty down well with a putty knife or spatula and smooth it off. Wipe off the surrounding surface with a damp cloth, and the job is done.

Such a filler, being porous, will accumulate dirt and become discolored. To avoid this, coat the filling twice with white enamel or lacquer.

Another excellent filler is one of the prepared patching plasters, which come in dry form and can be bought at hardware and paint stores.

Putty mixed from white lead paste, dry whiting and a few drops of varnish or japan drier makes one of the toughest and best fillings for such cracks. Such a filling will take two or three days to get dry, but eventually it will become almost as hard as stone. It is not a porous filling that will catch dirt, but a coating of lacquer or enamel will make it still smoother and better.

Another type of filling is plastic paint, which comes in dry form. When wet with just enough warm water to make it stiff and plastic, it can be used as described for plaster of Paris.

Cracks and other openings about kitchen sinks and lavatories may be filled in the same way. The enamel or lacquer coating is necessary wherever water is likely to be splashed on the filling, except in the case of the white lead and whiting mixture.

Cracks in Plaster

THE defects found in plaster walls are settlement cracks at corners and elsewhere, fine cracks, door-knob bruises, abrasions made by furniture, toys and other objects, and nail and screw holes.

Very fine cracks are not large enough to be filled with putty, yet when painted they absorb the liquid and show up as flat streaks much wider than the cracks themselves. About the easiest way to conceal these fine cracks is to coat them with shellac or var- (*Continued on page 104*)

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

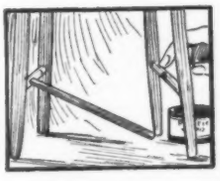
For the Handy Man and Every Man—

PLASTIC WOOD

Reg U. S. Pat. Off.

Handles Like Putty . . . Hardens Into Wood

HERE is wood that you can mould—a compound packed in air-tight tins so soft that it can be used like putty, but which hardens by action of the air into solid wood, waterproof and grease-proof, and adheres firmly to wood, metal, fabric, plaster or stone. It is invaluable in the home, for the automobile, and with boats. A few household uses are shown here, but their number is unlimited and each day brings reports of new successes.



Loose Rungs

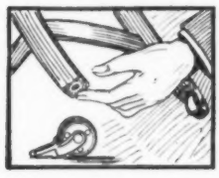
Pull out the rung. Scrape hole to remove dried glue or dirt. Half fill hole with Plastic Wood and force rung back in. Clean off loose particles. Allow rung to set overnight. It is often advisable to hold rung fast with string while Plastic Wood sets.

Pipe Holes

Scrape hole clean and fill around pipe with Plastic Wood, allowing the Plastic Wood to spread over edge of hole and slightly up the sides of the pipe. After the Plastic Wood hardens, trim level around the pipe with a sharp knife and sandpaper smooth. Paint, stain or varnish to desired color.

Baseboard Cracks

When the floor settles away from the baseboard Plastic Wood can be worked into the crack with the fingers or a knife and when hard, is easily sandpapered or pared smooth with a sharp knife, and painted or varnished to the color desired. Scrape crack clean before filling.



Loose Casters

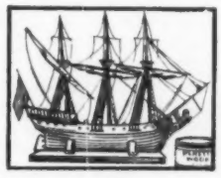
Remove caster and fill hole half full of Plastic Wood. Force caster back into hole. Remove Plastic Wood that is squeezed out, and allow chair to stand overnight before using.

Antique Furniture

Plastic Wood is widely used for repairing and strengthening antique furniture. Gouges can be filled, sandpapered and colored, missing decorations can be modelled; loose mouldings and pieces can be affixed; rungs and joints permanently strengthened; drawer pulls made secure.

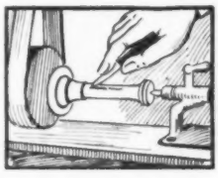
Model Boats

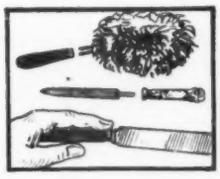
Plastic Wood is an invaluable aid in building model boats. It is ideal for filling cracks, making tops and crosstrees secure to masts, fastening down deck houses, bulwarks and fittings to the decks, sealing holes around masts and bowsprit, and for moulding figure-heads and decorations.



Wood Working

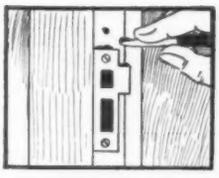
Plastic Wood is the one substance to satisfactorily repair mistakes or accidents in wood working, and its use will often simplify many tedious jobs. It can be used for strengthening joints and corners, and when hard, it can be chiseled, planed, sawed, turned in a lathe and worked like natural wood.





Loose Handles

On brooms, mops, carpet sweepers, brushes toilet articles and hand tools. Remove handle and insert sufficient Plastic Wood into hole so that when handle is forced back some Plastic Wood will be squeezed out. Allow handle to set well before using.



Locks, Latches, etc.

When it is necessary to move door locks, bolts or latches, Plastic Wood not only fills up the old holes with permanent wood, but can be used to cover any scarred surfaces around the hardware. Sandpaper for smoothness, and paint or varnish to the color of the surrounding surface.

Splinters

Cut off splinter from the wood and build up the splinter cavity with Plastic Wood, working with fingers or knife. After hardening, sandpaper or pare Plastic Wood to smooth finish, and color as desired.

Plastic Wood is carried at Hardware and Paint Stores, and by Ship Chandlers. It comes in natural wood color in 1 lb. cans at $1.00, and in ¼ lb. cans at 35 cents. For use in replacing loose tiles, and for cracked porcelain and enamel, there is a special preparation, Plastic Wood White Waterproof Tile Cement, in ¼ lb. cans at 35 cents.

Manufactured by The Addison-Leslie Company, 301 Bolivar Street, Canton, Mass.

PLASTIC WOOD

Trademark Reg. U. S. Pat. Off.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Not Only the MOST UP-TO-DATE --But the most *READABLE and DEPENDABLE* of *all Encyclopaedias!*

Clearness and simplicity of language, even in the treatment of the most technical subjects, makes Nelson's the most sensible, intelligent, and by far the most interesting of all the encyclopaedias.

Graphic Pictures in Great Profusion Clarify and Intensify the Text Impression following the modern tendency to quickly reach the mind through the eye.

No man is a specialist in every art and science. Therefore when he looks up a subject in Nelson's, its distinct clearness of treatment leaves with him a clearer understanding of the subject than he can ever hope to get from ordinary reference works. **Nelson's is graphic.**

Three great editorial staffs are constantly at work under the direction of John H. Finley, LL.D., Editor in chief, Former Commissioner of Education, and President of the University of the State of New York; and Associate Editors Sir Robert Falconer, Litt.D., LL.D., President of the University of Toronto, Canada; and Sir Henry John Newbolt, LL.D., Litt.D., Edinburgh, Scotland.

The importance of the loose-leaf feature of Nelson's Encyclopaedia is best illustrated by the fact that about 2,000 changes are made each year.

NELSON'S

Safeguards You Against Error. How can we in any important operation construct plans without a knowledge of the newest principles and methods? Every subject on which man would be informed is changing constantly. Nine times out of ten, the Information you want is on a subject of current importance. Only Nelson's loose-leaf system can keep you up-to-date. You do not use a City Directory that is two years old. Why use reference works far more dangerously obsolete?

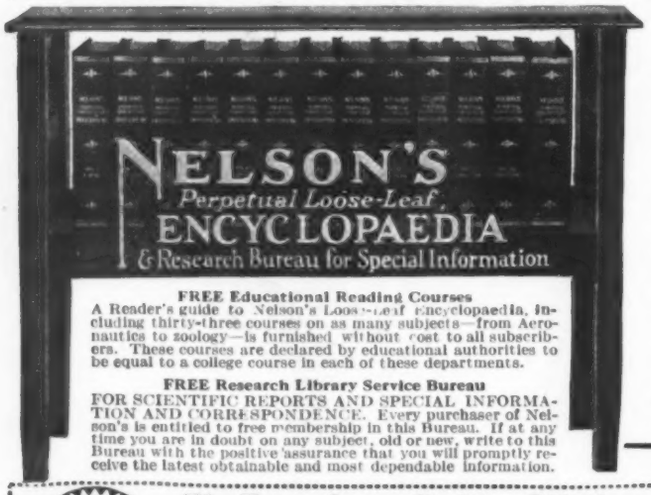
Nelson's Is the Recognized American Encyclopaedia. It is used in the Library of Congress, U. S. Senate, U. S. Supreme Court, and in Libraries, Universities and Schools in every state in the Union.

Think what this means to you—an Encyclopaedia **to last a lifetime**—and ALWAYS Up-to-date. Every Encyclopaedia except Nelson's is out of date within six months after it is published. The set you buy today will be as up-to-date ten, fifteen, or twenty years from now as the day you buy it.

Get the Interesting FREE Booklet

The coupon below will bring you a beautiful book of sample pages including illustrations and maps in full colors. Use it Today!

Nelson's Is a Complete Working Reference Library of World Knowledge that is always up-to-date. Profusely illustrated. New information is constantly substituted for obsolete matter. A complete detailed Atlas of the World. Latest population statistics. Biographies of prominent men and women, past and present. Index Volume containing over 200,000 references. A liberal education through Nelson's Reader's Guide Service, consisting of 33 full study College Courses, subjects from Aviation to Zoology. And FREE Research Library Service.



FREE Educational Reading Courses
A Reader's guide to Nelson's Loose-Leaf Encyclopaedia, including thirty-three courses on as many subjects—from Aeronautics to zoology—is furnished without cost to all subscribers. These courses are declared by educational authorities to be equal to a college course in each of these departments.

FREE Research Library Service Bureau
FOR SCIENTIFIC REPORTS AND SPECIAL INFORMATION AND CORRESPONDENCE. Every purchaser of Nelson's is entitled to free membership in this Bureau. If at any time you are in doubt on any subject, old or new, write to this Bureau with the positive assurance that you will promptly receive the latest obtainable and most dependable information.

Mail the Coupon Today for Full FREE Information

The Encyclopaedia for a Lifetime
THOMAS NELSON & SONS, 381 Fourth Ave., N. Y.
Originators of the Loose-Leaf Reference System Publishers for 130 Years

Please mail me FREE your portfolio of sample pages and full information how, by the budget easy payment plan I can own Nelson's Perpetual Loose-Leaf Encyclopaedia, with Free Membership in Nelson's Research Library Service Bureau for Special Information, and Nelson's Reader's Guide Free. (P. S. March)

Name ..... City .....

Address ..... State .....

(Adv. Copyright, 1928, by Thomas Nelson & Sons)

The Shipshape Home

(*Continued from page 102*)

nish and, when dry, to coat them again with flat paint of any kind before painting the entire wall or ceiling. It is also necessary to stop up these fine cracks thoroughly when wall paper, canvas or other fabric is to be applied. The cracks will absorb moisture from the paste and the covering will not stick to the dry paste.

When the cracks are large enough to allow a lead pencil point to be inserted, scrape the surface lengthwise with a bit of broken window glass to cut off the lip that makes one side higher than the other, if there is a lip. Next, run a putty knife or other sharp tool through the crack to make it as straight as possible and cut off loose projections from both sides. Remove all loose chips and fill the crack well with water, using a small brush; if oil putty is to be used, coat the crack with linseed oil, not water.

Probably the most convenient filling material is one of the prepared patching plasters. They set slowly and adhere to the surface without shrinkage. When dry, smooth up with No. 0 or No. ½ sandpaper and coat with shellac before painting, calcimining or covering with wall paper or fabric. It is well, too, to coat the shellac with flat paint before painting the entire surface, if it is to be painted.

Other putties can be made by adding dry whiting to any flat wall paint or to white lead paste thinned with a few drops of linseed oil.

All of the materials used for putty set slowly and allow plenty of time for the work, except plaster of Paris. A wad of this will begin to set in about five minutes after removing it from the water. It should not be used in that condition. A little dry whiting or hydrated lime added to the plaster of Paris slows down its setting without injury to it, but do not use the vinegar or the glue size sometimes recommended for that purpose.

Sealing Fire Cracks

When a wall or ceiling is completely covered with a network of fine "fire" cracks too small to be filled, it is too much work to shellac and flat-paint them. Other means are quicker and better. One of them is to apply a size coat consisting of one half first-class floor varnish and one half turpentine. Mix in also a little white lead or flat wall paint and a handful or two of dry, fine pumice stone.

A second method is to size the wall with a mixture of one gallon of boiled linseed oil and one quart of turpentine. In bad cases it is well to fill the larger cracks of this type before the varnish size, or before or after the oil size, is applied. Thin some white lead-in-oil paste or flat wall paint a little with turpentine, run a stripe over each crack, let it set about five minutes, and rub well into the cracks with a rag.

This is the first of a series of articles by Mr. Vanderwalker, who is one of the leading authorities on painting and decorating.

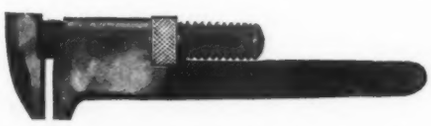
This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

TRIMO

TRIMO Pipe Wrench *Asks No Favors*

There are no strings attached to the TRIMO guarantee of unfailing performance and long wear. The TRIMO is a pipe wrench with a replaceable insert jaw in handle—ask for it.

TRIMO ®



Mechanics in every field recognize the outstanding advantages of the TRIMO Monkey Wrench. The movable jaw extends outward increasing the leverage with the size of the nut. The threads are rounded to prevent locking or stripping.

TRIMONT MFG. COMPANY
ROXBURY (BOSTON), MASS.

America's Leading Wrench Makers for Nearly Forty Years

Ⓢ This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Damascus for Swords...

Western Electric for telephones

The swordsman of old gloried in the excellence of a Damascus blade. So, through the ages some one product of a craft has been outstanding. Today with telephones it is Western Electric.

Most of the readers of this advertisement have never used any other make of telephone. The reason for this takes you back half a century, when many manufacturers were making telephones and the Bell Company selected Western Electric for sheer merit.

Because of this relationship with the Bell System, Western Electric has been able steadily to improve its product. Engineers of your telephone company, alert to better the service, work hand in hand with engineers of Western Electric, eager to produce the superior equipment needed.

Thus your telephone makers are edging up on perfection.

Western Electric

Purchasers... Manufacturers... Distributors

SINCE 1882 FOR THE BELL SYSTEM

Blueprints for Your Home Workshop

ANY ONE of the blueprints listed below can be obtained for 25 cents. The blueprints are complete in themselves, but if you wish the corresponding back issue of the magazine in which the project was described in detail, it can be had for 25 cents additional so long as copies are available.

Popular Science Monthly
250 Fourth Avenue, New York

Send me the blueprint, or blueprints, I have underlined below, for which I inclose.....dollars.....cents

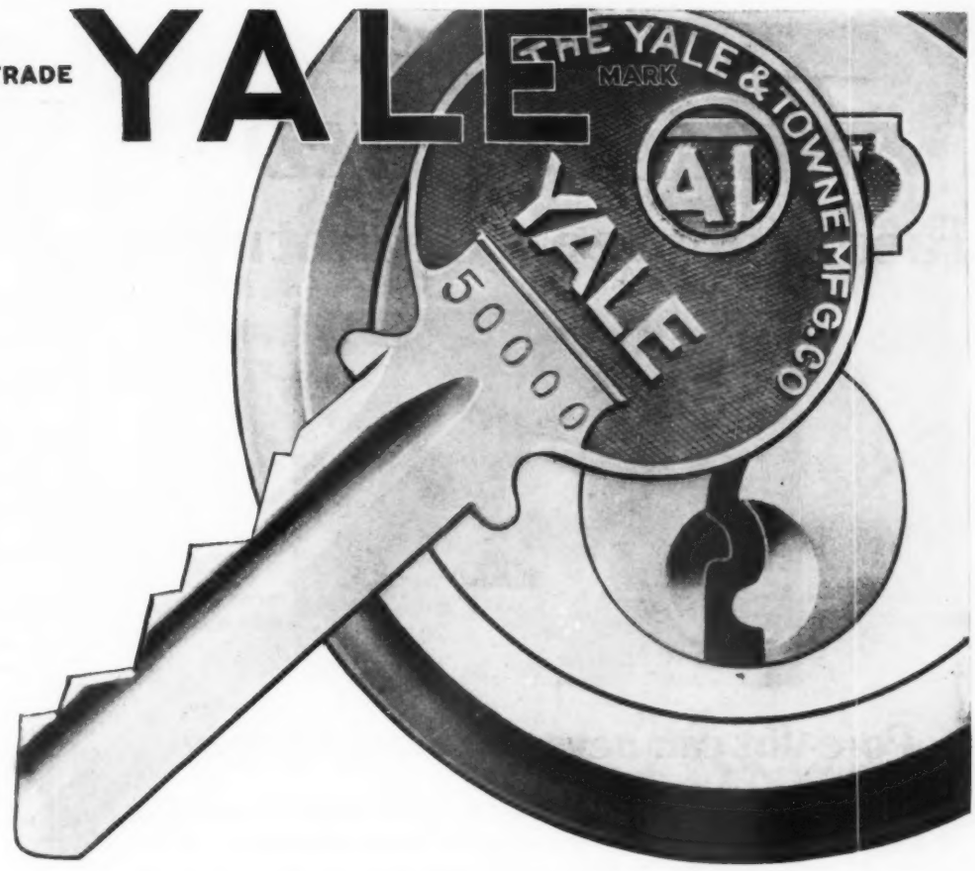
No.	Title	Described in Issues of		Price
1.	Sewing Table	Feb.,	'22	25c
2.	Smoking Cabinet	Mar.,	'22	25c
3.	End Table	Apr.,	'22	25c
5.	Kitchen Cabinet	May,	'22	25c
9.	Arbor, Gate and Seats	July,	'22	25c
10.	Porch Swing	Aug.,	'22	25c
11.	Bench and Tilt Table	Sept.,	'22	25c
13.	Tea Wagon	Nov.,	'22	25c
14.	Christmas Toys	Dec.,	'22	25c
15.	Workshop Bench	Jan.,	'23	25c
16.	Inlaid Radio Cabinet	Feb.,	'23	25c
17.	Cedar Chest	Mar.,	'23	25c
18.	Phone Table and Stool	Mar.,	'23	25c
19.	Grandfather's Clock	Apr.,	'23	25c
20.	Flat Top Desk	Apr.,	'23	25c
21.	Colonial Desk	Apr.,	'23	25c
22.	Cabinet and Desk	Apr.,	'23	25c
23.	One-Car Garage	May,	'23	25c
24.	Gateleg Table	June,	'23	25c
25.	Canoe Sailing Outfit	July,	'23	25c
26.	Baby's Crib and Pen	Sept.,	'23	25c
27.	Kitchen-Cabinet Table	Oct.,	'23	25c
28.	Pullman Play Table	Nov.,	'23	25c
29.	Toy Tea Cart, etc.	Dec.,	'23	25c
30.	Tool Cabinet, etc.	Jan.,	'24	25c
31.	Sewing Cabinets	Feb.,	'24	25c
32.	Chinese Game Table	Mar.,	'24	25c
33.	Dining Alcove	Apr.,	'24	25c
34.	Garden Trellises	May,	'24	25c
35.	Simple Radio Cabinet	Oct.,	'24	25c
36.	Rush-Bottom Chair	Nov.,	'24	25c
37.	Simplified Bookcase	Dec.,	'24	25c
38.	Small Drop-Leaf Table	Jan.,	'25	25c
39.	Salem Chest of Drawers	Feb.,	'25	25c
40.	Small Drop-Front Desk	Mar.,	'25	25c
41.	One-Tube Radio Set	May,	'25	25c
42.	Three-Stage Amplifier	June,	'25	25c
43.	Four-Tube Receiver	July,	'25	25c
44.	Pirate Ship Model—Hull	Feb.,	'26	25c
45.	Pirate Ship—Details	Mar.,	'26	25c
46.	Galleon Model—Hull	May,	'26	25c
47.	Galleon Model—Details	June,	'26	25c
48.	Sailing Yacht Model	July	'26	25c
49.	Broom Cabinet	Aug.,	'26	25c
50.	Airplane Model (Flying)	Sept.,	'26	25c
51.	Clipper Ship Model—Hull	Oct.,	'26	25c
52.	Clipper Model—Details	Oct.,	'26	25c
53.	Clipper Model—Rigging	Nov.,	'26	25c
54.	Five-Tube Radio Set	Oct.,	'26	25c
55.	Five-Tube Set—Details	Oct.,	'26	25c
56.	Bird and Animal Toys	Dec.,	'26	25c
57.	*Constitution* Model—Hull	Jan.,	'27	25c
58.	*Constitution*—Rigging	Feb.,	'27	25c
59.	*Constitution*—Rigging	Mar.,	'27	25c
60.	Welsh Dresser	Mar.,	'27	25c
61.	Viking Ship Model—Hull	Apr.,	'27	25c
62.	Viking Ship—Details	Apr.,	'27	25c
63.	Toy Motor Boat—Hull	May,	'27	25c
64.	Toy Motor Boat—Details	May,	'27	25c
65.	Six Simple Block Puzzles	June,	'27	25c
66.	Ship-Model Weather Vane	Aug.,	'27	25c
67.	Toy Model of Lindbergh's New York-to-Paris Plane	Aug.,	'27	25c
68.	Magazine-Rack Table and Book-Trough Table	Sept.,	'27	25c
69.	Flying Model (3 ft.) of Lindbergh's Monoplane	Oct.,	'27	25c
70.	Console Radio Cabinet	Nov.,	'27	25c
71.	Console Cabinet—Details	Nov.,	'27	25c
72.	Doll's House	Dec.,	'27	25c
73.	Doll's House Furniture	Dec.,	'27	25c
74.	*Santa Maria* Model—Hull	Dec.,	'27	25c
75.	*Santa Maria*—Rigging	Feb.,	'28	25c
76.	*Santa Maria*—Details	Jan.,	'28	25c
77.	Simple Pier Cabinet and Decorative Wall Shelves	Jan.,	'28	25c
78.	Simple Treasure Chests	Feb.,	'28	25c
79.	Electric Radio Set	Feb.,	'28	25c
80.	High Power Unit for Electric Radio Set	Mar.,	'28	25c
82.	Simple Single-Stick Airplane Model (30-in.)	Mar.,	'28	25c

Name.....
(Please print name and address very clearly)

Street.....

City and State.....

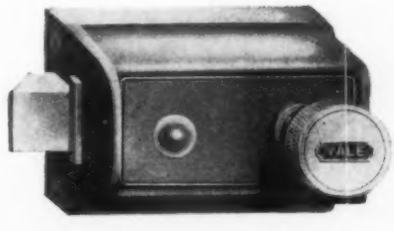
This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.



SYMBOLS OF PROTECTION AND SECURITY IN A WORLD WHERE TEMPTATION HAS INCREASED IN PROPORTION TO PROSPERITY.

There is only one maker of Yale Locks and Keys.
The mark Yale means the name of the maker.

The Yale & Towne Mfg. Co.
Stamford, Conn., U. S. A.
Canadian Branch at St. Catharines, Ont.



YALE MARKED IS YALE MADE

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

EVEN TWICE WASHED Faces don't seem clean at night

Pore-dirt can never be washed away

A HARD-SCRUBBED face may *seem* clean enough when seen across the aisle of a car or over the desk in an office. But a face simply has to *be* clean when shown close up under night lights . . . or somebody's going to be the loser.

When you wash your face, the *surface* gets clean. But look in a mirror—now—and see the pore-dirt that *can't* be washed away. It's *under* the surface of your face this very minute.

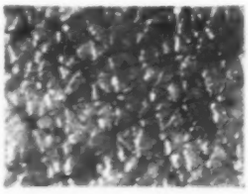
Pore-dirt dulls the cleanest complexion. It needn't! And we'll gladly send a FREE tube of Pompeian Massage Cream to prove it to you.

Goes in pink...*ROLLS OUT DINGY GRAY!*

THESE amazing photos show what happens when Pompeian Massage Cream gets after pore-dirt. Number one shows a section of skin before using Pompeian. Number two shows the skin after a few seconds' Pompeian massage.

The cream was a clean pink when it went into the skin. But notice its color—*now!* Those dried pellets of cream are a dingy gray . . . gray with pore-dirt . . . dirt that couldn't have been dislodged by a heavy course of scrub-downs!

And that's the sensational demonstration that turns men by the hundreds to this remarkable cream.



1. *Photomicrograph taken under lens of powerful microscope showing section of skin before using Pompeian Massage Cream.*

2. *Photomicrograph of skin after using Pompeian. Compare the skin tone. Note the dried pellets of cream, dark with pore-dirt that has been rolled free.*

Make FREE test that convinces thousands

Will you try Pompeian on your own skin? Test it—please—at our expense. Fill in the coupon below and mail it to us now, before you turn this page.

POMPEIAN MASSAGE CREAM

The Pompeian Company, Dept. 901-C, 595 Fifth Ave., New York. Gentlemen: Please send me a free trial tube of Pompeian Massage Cream . . . enough for two cleansing, invigorating facial massages.

Name_____

Street_____

City_____ State_____

Tricks of the Toolmaker

(Continued from page 88)

correction should be made with the dial indicator. This method will prove safer than relying on the dial on the machine, especially if the error is in the opposite direction to the last setting.

If the 9/16-in. reading proved to be accurate, the operator has no reason to worry. Nevertheless, every hole should be checked undersize, which is much safer than the ordinary method of doing this before starting to bore by using the plug gage in the chuck.

For hole No. 2 time is saved by coming to side *D* and getting the hole accurate from the two sides. The 3.750-in. spacing will prove correct because of the accurate dimensions of the plate being bored. Moving back to side *D*, the .875 spacing is taken lengthwise. No. 4 hole is located and bored, then No. 3 hole from side *A*, and so forth until all the holes have been located and bored.

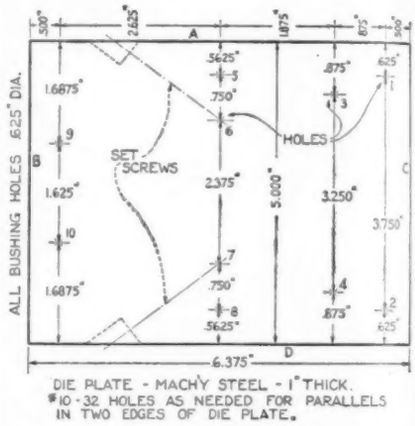


Fig. 4. Die plate for a piercing punch and die used in manufacturing hack saw backs

This may appear to be a very long job, but accuracy here is the main factor, as the stock punched out with the finished punch and die is bent perfectly central and the holes must line up.

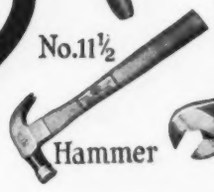
The upper of the two drawings in Fig. 5 shows a job that can be laid out quickly and accurately by using four buttons at a time.

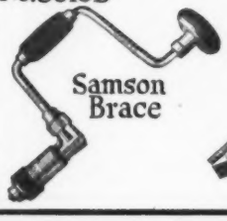
Figure 2 illustrates the method of making a plate to be used as a distance testing fixture. The plate itself is shown in the lower drawing of Fig. 5. It is made of die steel, laid out the usual way, hardened and ground all over to exact dimensions. The .375- and .500-in. holes must be accurate within .0001 in. The allowance for grinding, including the holes, is .010 in.

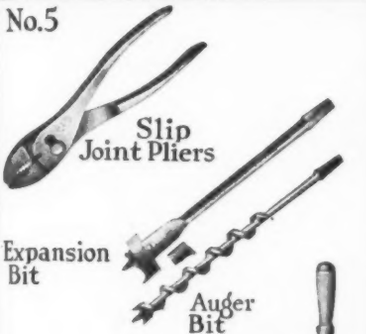
The piece is surfaced off and squared to size on the surface grinder. The faceplate of the universal grinder is ground square and the testing plate is clamped to it. The .500-in. hole is trued up with the indicator; it is then ground .0005 in. undersize. The plate is removed from the machine and the hole lapped a good fit on the .500-in. plug gage. The .375-in. hole is then plugged with a piece of soft steel. After the end of the plug has been squared, it is drilled and tapped for the movable button. The distance is now laid out *(Continued on page 110)*

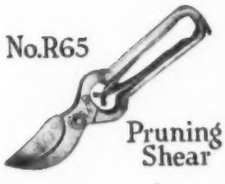
This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

PEXTO









Tools You Need—

In order to work successfully at a mechanical trade or to take pleasure in making things at home you need good tools, that will stand up and do the work required of them.

"It's a PEXTO" is all you need to know to assure you that it is a tool of highest quality and fully guaranteed as to workmanship and material.

The line consists of Bit Braces, Auger Bits, Squares, Chisels, Hammers, Hatchets, Pliers, Monkey and Pipe Wrenches, Angle Wrenches, Screw Drivers, Snips, Compasses, Pruning Shears, Dividers, Calipers, Pincers, Soldering Coppers, and many other small tools.

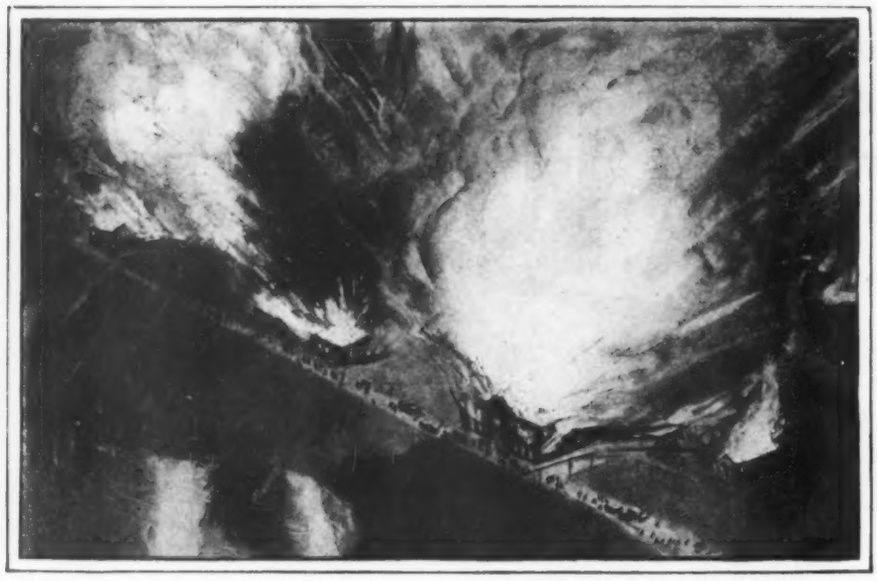
PEXTO TOOLS are carried by practically all progressive dealers. Ask your dealer to show you these tools.

Write us for Booklet covering our complete line

THE PECK, STOW & WILCOX CO.
SOUTHINGTON, CONN., U.S.A.

Worth While Tools

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.



The Spirit of Service

An Advertisement of the American Telephone and Telegraph Company

In July, 1926, lightning struck the Navy Arsenal at Denmark Lake, New Jersey. The explosion demolished the $80,000,000 plant, rocked the countryside, left thousands homeless and many dead. While the community fled in terror, fresh explosions hurled fragments of shell and debris far and wide.

High upon the roster of those who responded to the call of duty were the telephone workers. Operators in the danger zone stayed at their posts. Those who had left for the day and others on vacation, on their own initiative, hurried back to help handle the unprecedented volume of calls. Linemen and repairmen braved exploding shells to restore the service. Within a little over an hour emergency telephone service was established, invaluable in caring for the victims and in mobilizing forces to fight the fire which followed.

In spite of repeated warnings of danger still threatening, no telephone worker left the affected area.

Through each of the day's twenty-four hours, the spirit of service is the heritage of the thousands of men and women who have made American telephone service synonymous with dependability. In every emergency, it is this spirit that causes Bell System employees to set aside all thought of personal comfort and safety and, voluntarily, risk their lives to "Get the message through."

Tricks of the Toolmaker

(*Continued from page 108*)

with the plug gage in the other hole. The plate is trued up again from the button and made secure on the faceplate. The plug, which should not be tight in the hole, is pushed out with a rod running through the spindle. The hole is then ground to .005 in. undersize and a test is made with a plug gage. If the distance is correct, the hole is finished to .0002 in. undersize and lapped. The small allowance for lapping this hole is reasonable on account of the exact limits in respect to the spacing.

In many cases the boring is done in the punch and die holders instead of steel plates. The first hole in each holder is laid out to match and the others are

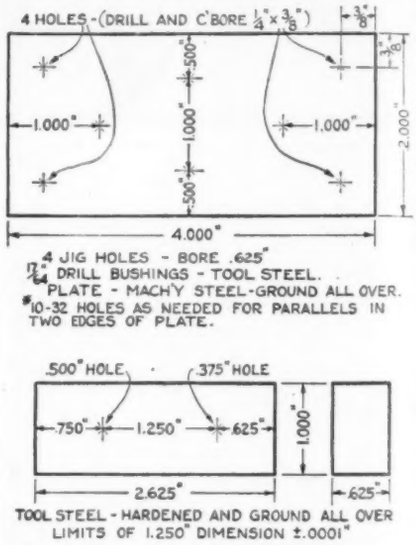


Fig. 5. A jig plate that can be laid out by using four buttons at a time, and a testing fixture, which is shown set up in Fig. 2

spaced and bored from these individually. The post holes in the punch holder are generally bored much larger than the posts. After the punch and die are fitted in each other, the holes in the punch holder are babbitted, thereby insuring a perfect line-up of the entire job.

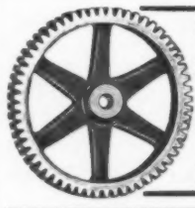
It often occurs that many flat pieces have to be bored in the lathe, sometimes two or three holes in the same piece, not necessarily exact work. These jobs are costly on account of the time spent getting the locations. By drilling these clear through and counterboring one side with a medium-size center drill, and making a quick-locating center as in Fig. 3, much time can be saved. The tool will prove handy and will soon pay the initial cost. It is made of machinery steel, only the point of the center being casehardened.

A collet is made to fit the lathe spindle accurately. A sliding center acting on a coil spring fits the bore in the collet. One end of the rod passing through the spindle is fastened to the back end of the center; the other end is threaded for a small handwheel. Guided by the center hole, the piece to be drilled is brought against the center and pressed to the faceplate. Clamps, which have previously been set handy, are tightened. The center is now drawn away enough to clear the work and the job is ready for boring.

Model Ship Builders
Construction Sets and All Sorts of Supplies

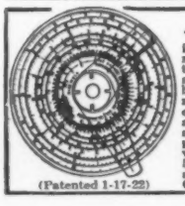
Whether you are building the True Santa Maria, or any other Popular Science model, our new illustrated catalog will save you time and money. Sent postpaid upon receipt of 10 cents (coin preferred).

Model Ship Supply Co.,
Dept. R Mineola, N. Y.



GEARS
All Kinds-Small
The most accurate made and prices reasonable. We carry a complete line of gears in stock for immediate shipment. Can also quote on special gears of all kinds. Send us your inquiries.
Write for Catalogue 214
CHICAGO STOCK GEAR WORKS
105 South Jefferson Street Chicago

GERSTNER CASES
are GOOD *Cases*
Machinists, Toolmakers
and other particular mechanics appreciate their splendid qualities. Catalog free. Write for it to-day
H. GERSTNER & SONS
551 Columbia St., Dayton, O.



The Midget
"Five-in-One" Slide Rule
is a combination Mannheim, Polymetric, Log-Log, Binary, Add and Subtract Slide Rule. It will instantly add, subtract, multiply and divide any combination of whole numbers, fractions, mixed numbers and decimals. Gives every root and power, also Logs, Sines and Tangents. Made of aluminum with scales on white celluloid. Size 4 in. Approved and adopted by colleges. Price with instructions, $1.50. Leather Case 50c extra. Sent C.O.D. if desired. Catalogue Free. GILSON SLIDE RULE CO., Stuart, Florida
(Patented 1-17-22)

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Leaky pails

Cracked water jackets

Cracked sinks

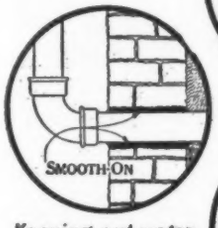
Anchoring bolts

For Hundreds of Odd Jobs

Smooth-On is as necessary as a hammer and screwdriver

Cracked boilers

Loose broom handles



Keeping out water where pipes go through walls

Loose drawer handles

EVERY time you use Smooth-On No. 1 you save money. Maybe it is fifty cents saved on mending a pail, kettle or pot—maybe $5.00 saved on repairing a leaking tank, hose connection or radiator on the automobile—or it may be a $15.00 plumbing bill.

With a few cents worth of Smooth-On you can *permanently* stop leaks in the gas, oil or coal stove; hot-air furnace, steam or hot-water boiler; steam, water or gas pipes, smoke stacks and air ducts; radiators, gas fixtures, water tanks, etc. With this dependable Iron Cement you can set loose broom handles, locks, door knobs, screws, casters, bathroom fixtures, tool handles, set hooks in masonry walls, etc. On your car, you can repair cracked water jackets, radiator leaks, gasoline, oil or water leaks, make loose grease cups, nuts and hub caps stay tight, etc.

Doing your own repairing with Smooth-On No. 1 enables you to keep the repair money in your own pocket, to demonstrate to your wife, your ability as a handy man, to avoid delays and annoyance while waiting for outside repairmen, and gives you the satisfaction of being self-dependent. Once familiar with what Smooth-On No. 1 can do, you will smile at many jobs that you formerly wished you could dodge.

Smooth-On No. 1 is sold in 7 oz., 1 lb. and 5 lb. cans. If you can't get the size you want from your dealer, write us direct.

FREE REPAIR BOOKLET: Send today for the guide booklet that tells how to make hundreds of Smooth-On home and automobile repairs. It will become a valued part of your equipment. Meanwhile, stop in at your Hardware Dealer and get a small can of Smooth-On No. 1 as a starter. You will bless the day you discovered—

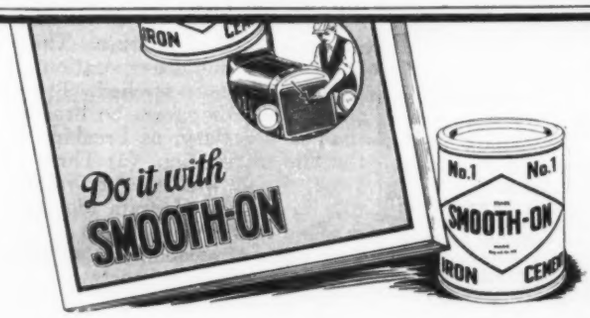
Leaky radiators

Loose tool handles

Leaks in smoke pipes

SMOOTH-ON NO. 1

Return the coupon for FREE copy of the SMOOTH-ON REPAIR BOOK



SMOOTH-ON MFG. CO., Dept. 58,
574 Communipaw Ave., Jersey City, N. J.

Please send the free Smooth-On Repair Book.

Name .....

Address .....

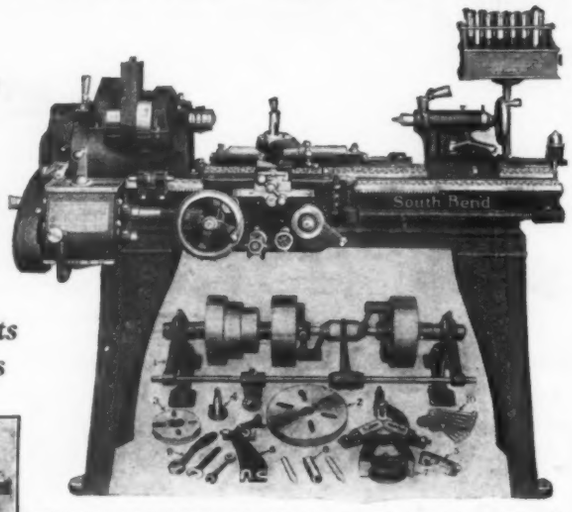
3-28 .....

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

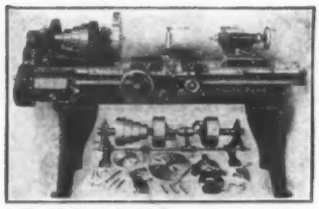
SOUTH BEND LATHES

FOR
Tool Room
Manufacturing
Machine Shop
Repair Shop
Service Station
Laboratory
Engineering Shop

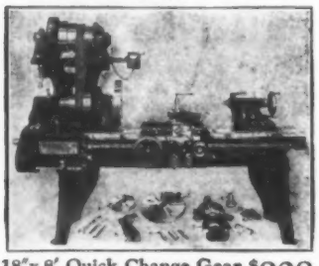
Precision
Popular Prices
Practical Attachments
Easy Payment Terms



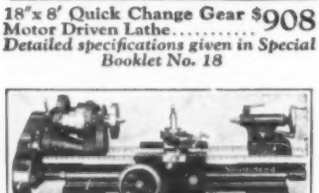
11"x4' New Model Precision Tool Room Lathe with Countershaft and Regular Equipment $335
One of the types illustrated in Special Booklet No. 11



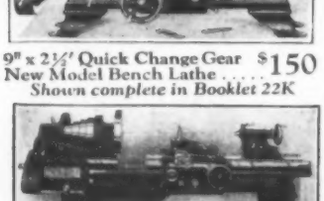
16"x 8' Quick Change Gear Lathe, Straight Bed $570
Described fully in Booklet No. 16



18"x 8' Quick Change Gear Motor Driven Lathe $908
Detailed specifications given in Special Booklet No. 18



9" x 2¼' Quick Change Gear New Model Bench Lathe $150
Shown complete in Booklet 22K



16"x 6' Quick Change Gear Gap Bed Lathe $620
Shown complete in Booklet No. 16

Other Popular Selling Sizes

The Prices of Popular Selling Sizes with Countershaft and Equipment

Size of Lathe	Shipping Weight	Standard Change Gear	Quick Change Gear
9" x 3'	490 lbs.	$235.	$270.
11"x 4'	725 lbs.	$300.	$335.
13"x 5'	1110 lbs.	$352.	$402.
15"x 6'	1550 lbs.	$430.	$490.
16"x 6'	1875 lbs.	$480.	$540.
16"x 8'	2035 lbs.	$510.	$570.
18"x 10'	2840 lbs.	$685.	$750.

Easy Payment Plan—10 Months to Pay

25% or ¼ down payment, balance in 10 equal monthly payments, or you can purchase through your nearest machinery dealer.

FREE—Write for No. 88 Catalog and New Booklets

Six special descriptive booklets listed below illustrate, describe and price 210 sizes and types of NEW MODEL South Bend Lathes. New General Catalog also illustrates and describes the complete line of New Model Lathes, Attachments, Chucks and Tools. Over 300 illustrations showing work the lathes will do.

Check off in the squares below, indicating the lathes in which you are interested. Tear this sheet out of the book and mail to us. Special booklets and Catalog No. 88 mailed free postpaid on request.

☐9" Lathe Booklet ☐16" Lathe Booklet
☐11" Lathe Booklet ☐18" Lathe Booklet
☐13" Lathe Booklet ☐New General Catalog No. 88
☐15" Lathe Booklet ☐'How to Run a Lathe', price 25c

Established 1906—Over 38,000 Lathes in Use

SOUTH BEND LATHE WORKS
Main Office & Works, 844 E. Madison St., South Bend, Ind., U.S.A.
New York City Salesroom, 183 Centre Street

BUILD YOUR OWN CLOCK WITH OUR HELP

Profitable spare time work for winter. Turn idle hours into welcome dollars building clocks from our instructions. We furnish plans, instructions, blueprints, works, dials and all materials at surprising low prices.
You make a big profit building artistic clocks for your friends.

Banjo Clocks, Mantel Clocks, Beautiful Grandfather Clocks with Chimes. Complete works as low as $5.00. Many styles, all prices. ASK FOR OUR ATTRACTIVE FREE BLUEPRINT PLAN AND CATALOG.

American Chime Clock Co.
1691 Ruffner Street, Philadelphia

Thompson BEATS the World on BOATS

BETTER BOATS at Lower Prices

The BEST that Skill and Experience can Produce

TWO BIG FACTORIES

Our complete line of 22 models offers you a variety to choose from. Prompt shipment from factory to you.
Catalog Free—Save Money—Order by Mail
Please state kind of boat in which you are interested.

219 THOMPSON BROS. BOAT MFG. CO. (20)
Ann St., PESHTIGO, WISCONSIN (Write to either place) 119 Elm St., CORTLAND, NEW YORK

Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

SURFACES to be painted, whether wood, metal or composition, must be dry and clean. Any knots and sappy spots in woodwork must be covered with shellac. Cracks and depressions are first painted with linseed oil and then are smoothed over with putty. Iron must be free of rust before it is painted.

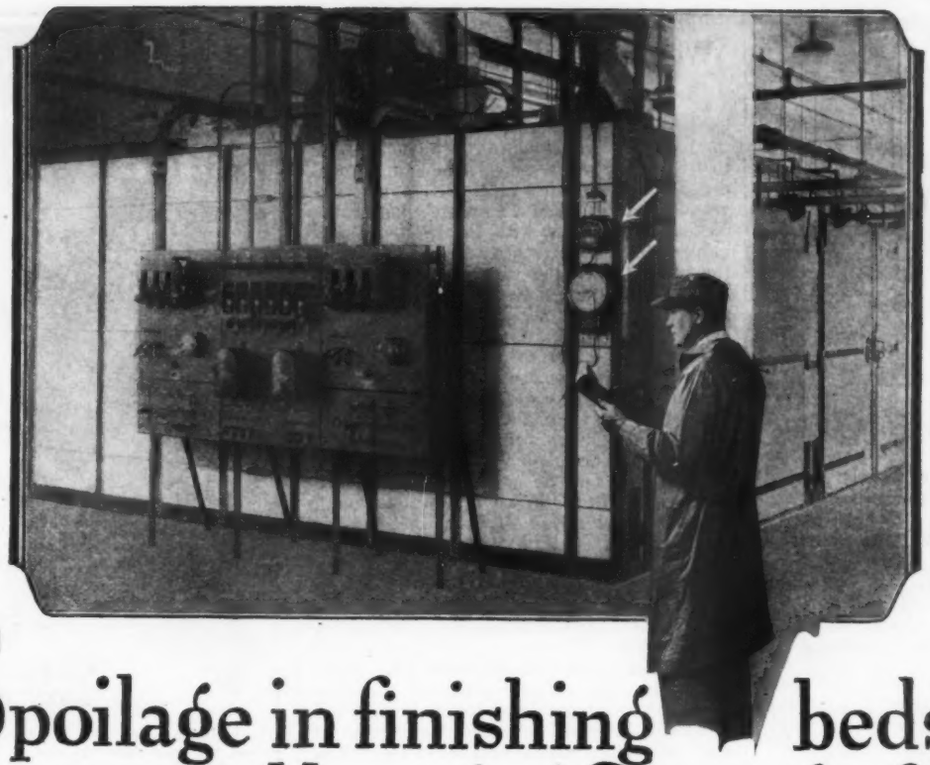
At times it is necessary to remove the old paint before an object can be repainted. The removal of paint on work of importance is usually accomplished with a commercial paint and varnish remover, except in the case of house paint, which is burned off. Much cheaper than commercial removers is a mixture of soft soap and burned and powdered lime (calcium oxide), to which an inert material like sawdust, flour, starch or chalk is added. This saponifies the paint and varnish, loosening it so that it may be easily scraped off with a dull knife or scraper. The surfaces then must be washed thoroughly with water. The mixture stains the wood to a certain extent, especially any wood rich in tannin like oak. This may be overcome, after the paint has been removed and the wood washed with water, by applying dilute sulphuric acid, made by pouring and stirring two parts of the acid slowly into eight parts of water. The acid neutralizes any alkali remaining in the pores of the wood, but it, in turn, must be removed by washing with water.

When white paint has a yellow tinge, a few drops of ultramarine blue oil color (a tube color) will neutralize it

Other solutions, such as the commercial removers, merely dissolve paint without affecting the wood in any way. The chemicals used, however, are more expensive and require two or more applications, especially if the paints are very hard. Among them are the lighter petroleums, carbon bisulphide, acetone, wood and grain alcohols, carbolic acid and chloroform. Some of these are volatile, others are poisonous, while others are combustible. Four formulas are:

(1) Equal parts of acetone and carbon bisulphide, with 2 oz. of paraffin added for each quart of mixture. The paraffin prevents too rapid evaporation after the remover has been applied. The mixture should not, therefore, be brushed more than is necessary, as brushing disturbs the film of paraffin. (2) Three parts of amyl alcohol and one of grain alcohol. (3) Four parts of grain alcohol, six of gasoline and one of amyl acetate. (4) Five parts of alcohol, five of benzol and one half part of amyl acetate.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.



Spoilage in finishing bedsteads is prevented by using *Tycos, the Sixth Sense*

IT IS easier to spoil the finish on a bedstead in an enameling oven than it is for the housewife to burn a pie. Underheating means a *soft* finish; overheating means a burned finish—either means the finish on the products being enameled is ruined.

Whether you make enamel bedsteads or bon bons, steel girders or doughnuts, if your products go through heat treating processes in their making or finishing it will pay you *in money saved* to substitute the accuracy of *Tycos* Indicating, Recording and Controlling Instruments for the guesswork of the human senses.

Through the use of *Tycos* Indicating, Recording and Controlling Instruments, a Creamery saves $4,800 a year . . . a Manufacturer of automobile tires saves $10,000 a year . . . a Leather Company saves $936 annually . . . a maker of silk by the cupra-ammonia process saves $22,000 a year. These are definite savings testified to by manufacturers who have reported them to us. It will give us pleasure to give you the names of these manufacturers, and dozens of others who are making savings like these.

Possibly big savings similar to those made by these manufacturers can be made in your plant. It will commit you to nothing to consult with our engineers. *Tycos* Instruments for Indicating, Recording and Controlling are made in 8,000 varieties to fit all needs. We will be glad to supply you with informative literature on type of instruments you may be interested in. Or our engineer will consult with you on the application of *Tycos* to your particular manufacturing problem.

Taylor Instrument Companies

Main Office and Factory
ROCHESTER, N. Y. - - U.S.A.
Canadian Plant: *Tycos* BUILDING, TORONTO
SHORT & MASON, Ltd. Manufacturing Distributors in Great Britain

Tycos for the Home

***Tycos** Office Thermometers*
An aid in promoting human efficiency.

***Tycos** Bath Thermometers*
To enable you to get the most good from your bath.

***Taylor** Home Set*
Bake Oven Thermometer, Candy Thermometer, Sugar Meter. The secret of accurate results in Cooking.

***Tycos** Wall Thermometers*
To help you maintain a temperature in your house conducive to good health.

***Taylor** Quality Compasses*
To show you the right way in unfamiliar country.

***Tycos** Fever Thermometers*
A necessity in every home.

***Tycos** Stormoguide*
Forecasts the weather twenty-four hours ahead with dependable accuracy.

***Tycos** Hygrometer*
To enable you to keep the humidity of the atmosphere in your home correct at all times.

Tycos for the Medical Profession

***Tycos** Sphygmomanometer, Pocket and Office types.*

***Tycos** Urinalysis Glassware.*

***Tycos** Fever Thermometers.*

Your dealer will show them to you. Ask us, on a postal, for booklets on any of the above.

Write for Tycos *Bulletins*

THE ~ SIXTH ~ SENSE ~ OF ~ INDUSTRY

Tycos Temperature Instruments

INDICATING - RECORDING - CONTROLLING

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

"I *wish* I had his job"

"He hasn't been here nearly as long as I have, but he's earning three times as much. Seems to me he's the first man the firm thinks of whenever there is a good position open. Always makes good too. I wish I had started studying with the I. C. S. when he did. I'd be farther along today."

Are you just wishing for a better job too? Are other men getting the promotions you'd like to have? Are you letting the precious, priceless hours slip by unimproved?

You know as well as we do that you've got to *learn* more in order to *earn* more. And you know, too, that the best way to learn more is to take up a course with the International Correspondence Schools and study in the spare time that most men waste.

Isn't it better to start today than to wait a year or five years and then *wish* you had? The sooner you start, the sooner you're going to get ahead.

Mail the Coupon for Free Booklet

INTERNATIONAL CORRESPONDENCE SCHOOLS
"The Universal University"
Box 7667-E, Scranton, Penna.

Without cost or obligation, please send me a copy of your booklet, "Who Wins and Why," and full particulars about the subject *before* which I have marked X:

☐ Industrial Management	☐ Business Correspondence
☐ Personnel Management	☐ Show Card and Sign Lettering
☐ Traffic Management	☐ Stenography and Typing
☐ Accounting and C.P.A. Coaching	☐ Civil Service
☐ Cost Accounting	☐ Railway Mail Clerk
☐ Bookkeeping	☐ Common School Subjects
☐ Salesmanship	☐ High School Subjects
☐ Secretarial Work	☐ Magazine and Book Illustrator
☐ Spanish ☐ French	☐ Cartooning
☐ Advertising	

TECHNICAL AND INDUSTRIAL COURSES

☐ Electrical Engineer	☐ Architect
☐ Electric Lighting	☐ Architects' Blueprints
☐ Mechanical Engineer	☐ Contractor and Builder
☐ Mechanical Draftsman	☐ Architectural Draftsman
☐ Machine Shop Practice	☐ Concrete Builder
☐ Railroad Positions	☐ Structural Engineer
☐ Gas Engine Operating	☐ Chemistry ☐ Pharmacy
☐ Civil Engineer	☐ Automobile Work
☐ Surveying and Mapping	☐ Airplane Engines
☐ Metallurgy ☐ Mining	☐ Agriculture and Poultry
☐ Steam Engineering ☐ Radio	☐ Mathematics

Name .....

Street Address .....

City ..... State .....

Occupation .....

If you reside in Canada, send this coupon to the International Correspondence Schools Canadian, Limited, Montreal

I POSITIVELY GUARANTEE that you can produce wonderful, sweet music in three days and quickly play popular and classical selections.

No notes to read. No dreary practice. Just three short, simple lessons revealing every secret of my 12 years' success as a professional saw musician. Amaze your friends with this sensation of radio, vaudeville, orchestra and lodge entertainment. Send 10c for phonograph record of two beautiful Musical Saw solos which also entitles you to complete information about my special introductory offer of Saw, Bow, Hammer, and Resin, FREE with Course of Instruction.

MUSSEHL & WESTPHAL
815 West Water St. Fort Atkinson, Wis.

Wood Turning Simplified

(*Continued from page 100*)

heavy. To sharpen this type of chisel, place the bevel in contact with the oilstone, raise the chisel and slowly move it back and forth, pressing on the blade with the left hand. Reverse the chisel, place it absolutely flat on the oilstone, press on it with the left hand, and move it back and forth a few times. Repeat the process until the wire edge is removed. Test the sharpness of the iron on the thumbnail as in Fig. 1. If the iron is sharp it "takes hold"; if it is not sharp, the nail slides over it.

The skew chisel is ground so that two bevels are formed instead of one. The cutting edge should be at an angle of about 65 degrees to the side of the chisel. While grinding, grasp the handle firmly in the right hand, press down on the blade with the left, and hold the chisel at such an angle that the cutting edge is parallel with the axis of the grindstone or emery wheel as in Fig. 4. Whet the chisel on the oilstone.

THE parting or cutting-off tool has two bevels, which should be of equal length and meet in the ridge that runs through the center of the blade. If they do not meet at this point the tool will bind and stick in the wood.

The round-nose chisel is ground in much the same way as a gouge, and the diamond-point or spear-point chisel is held on the stone at an angle so that its edge is parallel to the axis as shown in Fig. 4.

When a tool is used for scraping, its cutting edge dulls more quickly than when it is used for cutting. To overcome this disadvantage and also to make the tool cut better, the edge is sometimes turned with a burnisher so that it forms a sort of miniature hook or burr. This is done after the tool has been sharpened as explained above. A good way to turn the edge is to clamp the tool in a vise and stroke its edge with a burnisher. The first stroke should be at about the same angle as the bevel. In the following strokes the burnisher is gradually raised, so that at the last stroke it is held almost in a horizontal position (see Fig. 2). It may be of advantage to turn the edge of square- and round-nose chisels and diamond-point chisels. The gouge and skew chisel are cutting tools and should not have their edges turned, neither should the parting tool, which has two bevels. The burnisher illustrated in Fig. 2 was made by grinding the teeth off a triangular saw file.

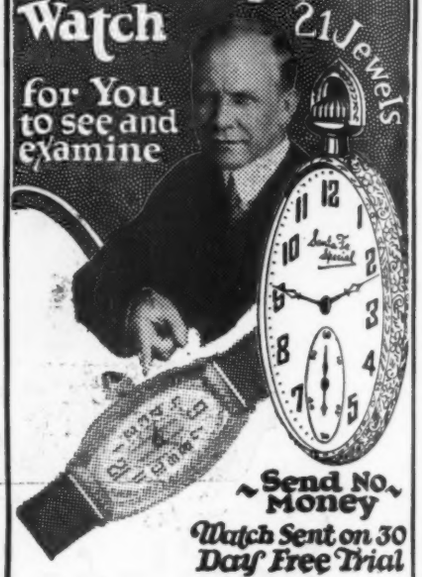
The oilstone and slip stone are hard, smooth stones used for whetting tools. Machine oil thinned with kerosene is a good lubricant to use on them.

This is the first of a series of articles on wood turning. The second will describe in detail how to do simple spindle turning. In preparing this material for POPULAR SCIENCE MONTHLY, Mr. Hjorth has drawn upon extensive teaching experience. He is now an instructor in the Architectural Laboratory of the Saunders Trade School, Yonkers, N. Y., and formerly was General Supervisor of Manual Arts and Director of Technical Work in Porto Rico.

A MEDIUM SIZE horseshoe magnet is an aid around the workbench for picking up tacks and small nails and screws that have fallen into the sawdust and shavings. With the aid of the magnet a whole box of tacks which have been spilled can be picked up quickly.—C.B.W.

BY WIPING NICKEL-PLATED hardware or other nickel-plated parts with a cloth moistened with a solution of one part sulphuric acid and fifty parts alcohol, rinsing quickly with clear water and drying immediately, it is possible to preserve the finish in its original brilliancy longer than if abrasive polishes are used.

I Want to Send You a **Santa Fe Special Watch** 21 Jewels for You to see and examine



Send No Money

Watch Sent on 30 Day Free Trial

In addition to our NEW LOW PRICE, I will send for your approval one of these Standard Watches, guaranteed for a lifetime of satisfactory service, not only by the Santa Fe Watch Company, but by the Great Illinois Watch factory. So accurate, Government officials carry them; so perfect and beautiful, jewelers say they are worth 1/3 to ½ more than we ask for them. I will send you one to see WITHOUT ONE PENNY DOWN—allow you to use it 30 days FREE—then sell it to you on easy payments.

Why Not Own a 21 Jewel Santa Fe Special Watch?

You will never miss the few cents a day that will make you own one of these watches—SEND FOR WATCH BOOK—illustrating in beautiful colors hundreds of designs and combinations in cases in the POCKET WATCH, MEN'S STRAP WATCH and LADIES' WRIST WATCH. You can have your name or monogram and any emblem you may desire engraved in the Case to suit your own ideas. Write today for Free Watch Book, and make your selection at once, while this offer lasts.

Ask for Special 30 Days Cash Offer

FREE A limited offer! With every Santa Fe Special, a beautiful gold chain or strand of exquisite pearls. Write today.

Mail Coupon for Both Watch and Diamond Catalog

SANTE FE WATCH CO.
Dept. 380 Thomas Bldg. Topeka, Kansas
(Home of the Great Santa Fe Railway)

Santa Fe Watch Company,
Dept. 380 Thomas Bldg., Topeka, Kan.
Please send prepaid and without obligation your Watch Book Free, explaining your "No Money Down" Offer on the Santa Fe Special Watch.

Name .....

Address .....

City ..... State .....

DIESEL ENGINES
Marine and Stationary
By ENSIGN DAVID L. JONES, U. S. Navy

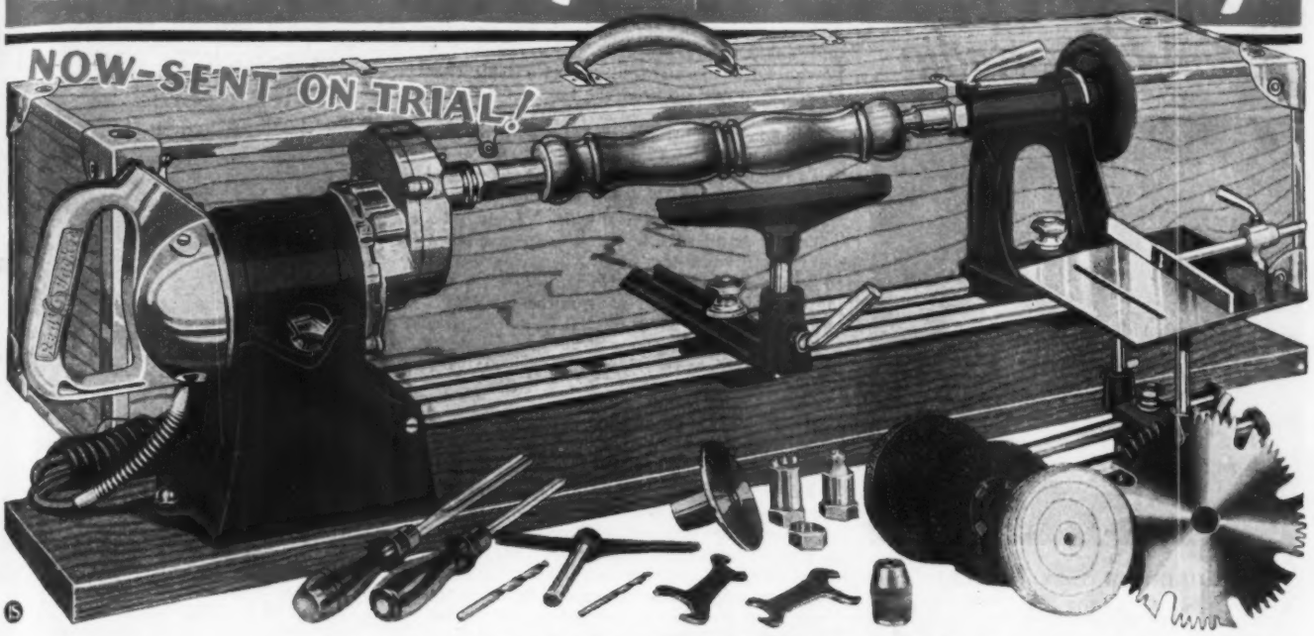
The most complete, thoroughly practical and up-to-date treatise on the Diesel Engine ever published. It explains their construction troubles, remedies, operation and adjustments, practical trials and tests and the elementary thermodynamics of all types of the Diesel Engine. The book is fully illustrated with drawings of working parts and detail engravings. 400 pages.

Price, $5.00

Popular Science Monthly
250 Fourth Ave. New York, N. Y.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

The Modern Craftsman's Wonder Shop



New 1928 Red Jacket Assembly

Five Thousand Red Jacket Craftsmen have made a bargain possible for you

Without Waco sales volume, no manufacturer could give the equivalent of *"Waco Shop No. 12"* at its price—*A Red Jacket Master Drill*, the *Waco Craftsman's Lathe*, the *electric power tools*, the *Jig Saw*, the *Red Jacket Band Saw*, or the Crafts Courses.

This equipment was designed, tested, approved and is guaranteed by Wm. L. Aylward, a nationally known craftsman and manufacturer, who has developed his hobby into a co-operative association of five thousand craftsmen.

Portable—Interchangeable—Complete HOME WORK SHOP

The new 1928 Combination of Electric tools brings you a Red Jacket Band Saw and in addition the powerful Red Jacket Master Drill Motor with direct drive to the Waco Craftsman's wood turning lathe (capacity 9 in. x 38 in.); a bench saw that has depth and side gauges, scroll and jig saw; and all accessories for both portable and stationary power drilling, buffing, grinding and cleaning. Attaches to any light socket and converts your work bench into a complete private tool and machine shop.

It is a complete chest full of electrically driven tools designed by a master for the private use of tool lovers and men who create, repair and appreciate handy tools at home.

The Waco GUARANTEE

If It Is Not What You Want When You Get It—Send It Back.

It Is Easy to Do These Things

Write or send coupon at once for valuable information to all interested in beautiful handiwork. It is free. It tells you how easy it is to operate a Red Jacket set of tools and lists the advantages and privileges that are free to member craftsmen.

Don't miss knowing all about Waco. It is free. You are invited.

Look out for imitations. There is only one Red Jacket—one Waco—one Wm. L. Aylward, Mastercraftsman.

Special Crafts Course FREE

SPECIAL CRAFTS COURSE and blueprint service is free to Red Jacket Shop owners—all that there is to know about handicraft methods, raw materials, woods, carving, sawing, turning, designing, carpentering, decorating, is taught by special correspondence.

Buy On Your Own Terms

Only $10.00 down. Liberal discounts for cash. Easy monthly payment plans. It is no hardship to own a Red Jacket.

Complete Only $10.00 Down 10 DAY FREE TRIAL

Tilt Top Table

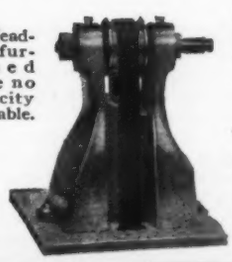
free BLUE PRINTS

SEND THIS COUPON

Interesting Literature Free

Send the coupon. You will be surprised with all it contains. Beautiful, Instructive, Fascinating, Interesting.

This Headstock furnished where no electricity is available.



Red Jacket MASTER DRILL

The most elaborate and unusual drill motor ever designed as driving power.

WACO TOOL WORKS, Inc.
542 N. Parkside Ave.
Chicago

Manager, Dept. 3. Please send me all free information and literature on Red Jacket Assemblies.

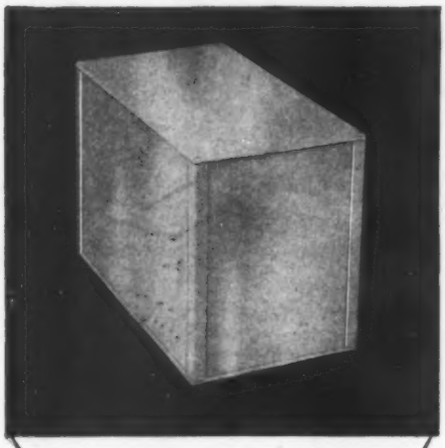
Name.....

Address.....

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

ALUMINUM

The mark of Quality in Radio



Aluminum Box Shields

Three of these shields are specified for the Popular Science Electric Set Ⓢ

FOR greater selectivity, finer appearance, longer life, lighter weight, use Aluminum Box Shields in the set you build.

Designers agree on the superiority of Aluminum for shielding. It has become an established factor in radio design.

Aluminum Company of America's standard box shields, designed especially for amateur sets, and specified for the Popular Science Monthly Electric Set, are made of heavy Alcoa Aluminum with satin-dip finish, size 5 in. x 9 in. x 6 in. high. They require no soldering.

If your dealer cannot supply you with standard Aluminum Box Shields send us your order and we will have an authorized dealer ship promptly by parcel post at $3.50 each. You simply pay the postman.

Write for free copy of the book, "Aluminum for Radio."

THE ALUMINUM COMPANY OF AMERICA

2459 Oliver Building Pittsburgh, Pa.

Powering Your Set

(*Continued from page 84*)

filed so that it will fit into the slots in the screws. This screw driver is necessary for two reasons: First, it eliminates hand capacity and makes balancing much easier. Second, it prevents the chance for a short circuit that otherwise would occur if the blade of an ordinary metal screw driver accidentally touched the shield or any other metal part while in contact with the screws on C4 and C5.

To balance, turn the drums to about 30 and set them so that the squeal is as loud as possible. Put the top on shields N3 and N2. Turn the screw of C4 with the special screw driver until you find a point where there seems to be a radical change in the squeal—a fluttering or broken effect. Now put the top on N1 and take off the cover of N2. You will find that by turning the screw of C5 you will come to a point where the squeal disappears. If it does not, turn the screw in C4 a trifle, first one way and then the other, and again readjust C5.

IT WILL pay you to take your time about the balancing and do it just as accurately as possible. As you have noted from the description of the electric receiver, the primary coil of each radio-frequency transformer (A1, A2 and A3 of Blueprint No. 79) moves away from the secondary coil as the condenser is tuned to the lower wave lengths. In laboratory tests it has been found that the receiver is just as selective at the lower wave lengths as it is at the higher waves. This means, of course, that the tuning is sharp at the lower waves. Incorrect setting of the balancing condensers C4 and C5 may upset the tuning on the short waves where a slight difference in capacity makes such a great difference in dial setting.

You may, for instance, get one balancing condenser set with a trifle too much capacity and the other with a shade too little. With such an adjustment you may find that there are two distinct points on the dial for each low-wave station. The remedy, of course, is to reset the balancing condensers until the double peak disappears.

ONCE these adjustments are made, you can push the set into the cabinet, for it will require absolutely no further attention until a tube gives out. As all these tubes are rated at 1000 hours of service, you probably will not have to touch the set except to turn it on and off and tune it for at least a year.

The volume control E2 will give you a perfectly smooth, distortionless control of volume on radio reception, but it has no effect on the volume with which phonograph records are reproduced when the phonograph pick-up unit is plugged into jack J. However, a special volume control is a part of the equipment that is included with the pick-up device. To use the pick-up device, simply turn on the set in the usual way, plug into jack J and start the needle on the record. To amplify your own voice just plug a pair of headphones into the jack and talk into one of them. You can make up all kinds of special programs to amuse your friends by doing your own announcing and playing records for the musical part of the entertainment.

The Parts to Use

This high power amplifier and current supply unit was designed without regard to expense for the radio fan who desires to build the finest possible outfit. In addition we wished to provide, as far as possible, for future developments that might make a still more powerful amplifier a practical possibility. This accounts for the 750-volt winding on the power transformer and the use of 1000-volt condensers in the filter circuit. Should a new and more powerful amplifier tube be brought out that required a greater voltage than the 210, (*Continued on page 118*)

AMERTRAN

Now Offers

Light-Socket Power and Finer Reproduction

The AmerTran ABC Hi-Power Box. List Price $95, east of the Rockies. Rectifying tube extra. Ⓢ

BEFORE you think of another set, think what these completely wired AmerTran products will do for the one you have. The ABC Hi-Power Box will deliver smooth power to plate and filament from the light socket, supplying sufficient voltage and current for push-pull 210 tubes and all other AC tubes required in a modern receiver. No batteries, liquids or chargers—no attention or adjustment necessary. This complete unit contains AmerTran-designed equipment, with a power transformer having seperate windings and capacities ample for practically any set.

With an AC power supply system or batteries, the fidelity of reproduction brought by the AmerTran Push-Pull Power Amplifier is actually limited only by the perfection of the speaker. Operated from the AmerTran ABC Hi-Power Box, the input to the speaker is free from distortion and objectionable AC hum. The energy output is increased especially at the lower musical frequencies, bringing greater clarity at high or low volume. The amplifier attaches to the detector of the receiver and is furnished with cable and plug to connect directly with the Hi-Power Box.

These two companion units are designed to work together, and with a good tuner and speaker will produce a philharmonic orchestra or pipe organ as though actually present.

See this new AmerTran products at any store displaying the sign "Authorized AmerTran Dealer" or, if you cannot obtain them, write direct to this Company. Both wired units are licensed under patents owned or controlled by RCA and must be sold complete with tubes.

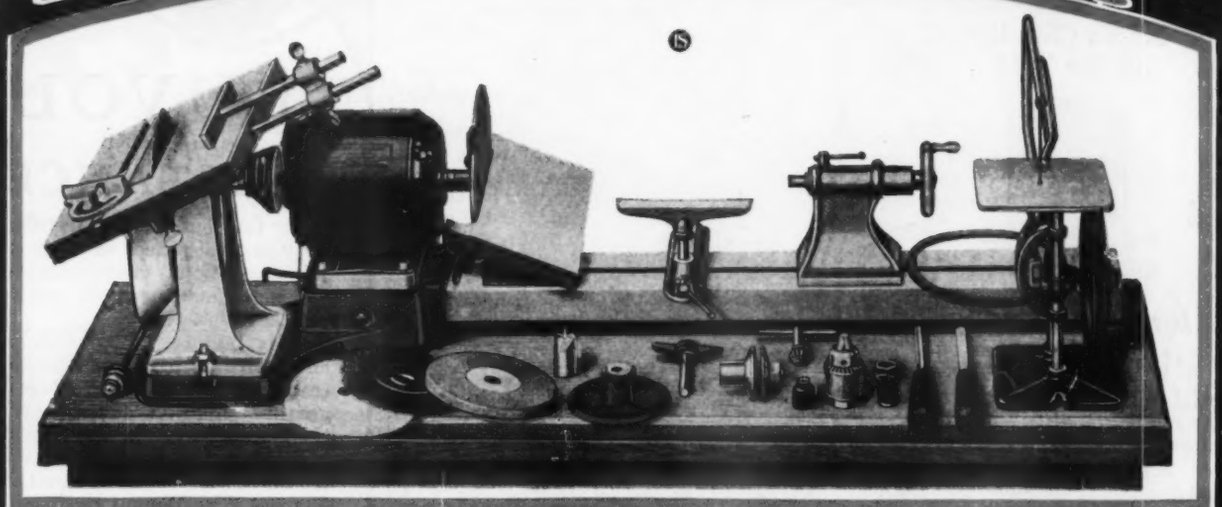
The AmerTran Push-Pull Power Amplifier. List price, $60, east of the Rockies. Tubes extra.

AMERICAN TRANSFORMER CO.

177 Emmet Street - Newark, N. J.

"Transformer Builders for over 27 Years"

Delta Handi-Shop



No Continuous Breaking Up of Operations

Because of its unusual and practical design the Delta Handi-Shop has overcome one of the greatest drawbacks in the average workshop—the continual breaking up of operations. The Delta has a two-shaft motor, therefore two tools are always ready for work. Suppose you are using the Circular Saw. Mounted on the other motor shaft is the Sanding Unit instantly ready for work. Think of the convenience—the big saving in time and unnecessary work. There are numerous other tool combinations that can be arranged easily and quickly on the Delta Handi-Shop as the combination described above.

Make these beautiful things, and hundreds of others, there is practically no limit to the work the DELTA will do.

Remember the Delta Handi-Shop is a BIG, STURDY, PRACTICAL workshop for home or commercial use. It cannot be classed in any way with the so-called portable shops. Think of a lathe bed of 4-inch U-section that is 36 inches long—48 inches long if you prefer—that will not chatter or spring. Think of a big, husky, fully-enclosed, powerful motor with a great overload capacity. Think of every accessory, and there are plenty of them, which are of the best quality obtainable—every one a nationally-known product.

We have built real machine-value into the Delta so that you can do the finest kind of work on it with amazing ease.

People who buy it say that it is far better than they expected a workshop could be—but you should see the shop itself and work with it to fully appreciate its outstanding qualities — its many novel and appealing features.

If You Are Fond of Good Tools

Send for our illustrated color folder. See how easy it is, with the Delta Handi-Shop, to gratify your desire to do more and better work. See how easy it is to do those things that no shop but the Delta has ever been able to do. Think of the money you can earn in full or spare time. How you can increase your profits by furnishing your employees with a real shop unit. Let the Delta help you develop your creative and inventive ability. Spend interesting, healthful, happy hours in using it in many ways you never dreamed of before.

Our Literature Is Complete and Interesting. Send for It Now.

DELTA SPECIALTY COMPANY
DEPT. MSP 328
858 3rd STREET, MILWAUKEE, WIS.

Delta Specialty Co. (Dept. MSP328)
858 3rd St., Milwaukee, Wis.

Send me your illustrated color folder describing Delta Handi-Shop. Tell me about your Free Trial Offer, Free blue prints and Easy Payment Plan.

Name.....

Street Address.....

City.....State.....

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

HAMMARLUND
Precision
PRODUCTS
Are Officially Specified For the Best Radio Circuits of the Year

Radio-Frequency
CHOKE COIL

Special winding and impregnating gives minimum distributed capacity for a given inductance and provides extremely high impedance to all broadcast frequencies. Distinctive Bakelite case. Two sizes: 85 and 250 millihenries.

Equalizing
CONDENSER

For neutralizing R. F. circuits or equalizing multiple tuning units. Small size fits limited space. Bakelite base, mica di-electric, phosphor-bronze spring plate.

Flexible
COUPLING

Permits coupling condensers in tandem without exact alignment. Bakelite insulation makes the two sides electrically independent of each other. Tough spring phosphor-bronze with brass bushings and hardened steel set screws.

Write for Folder

HAMMARLUND MFG. CO.
424-438 W. 33rd St., New York

For Better Radio
Hammarlund
PRECISION
PRODUCTS

Powering Your Set

(Continued from page 116)

this outfit could supply it merely by changing a few connections.

The power amplifier unit described here is, however, capable of such great volume with practically perfect tone quality that it is doubtful if any greater volume would prove of any practical value except in special cases.

It is quite possible, therefore, to materially reduce the cost of the unit by using less expensive filter condensers and the capacity also can be reduced without affecting the tone quality to any appreciable degree.

The condensers C1 to C6 as listed, that is, of 2 mfd. capacity rated at 1000 volts D.C. working voltage, cost in the neighborhood of eight dollars apiece, which would make the cost of the necessary condensers for the whole unit approximately fifty to fifty-five dollars.

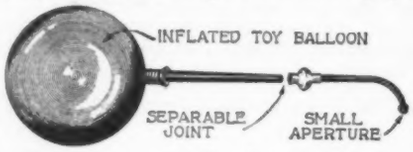
BY ELIMINATING condensers C2, C4 and C5, you can save about twenty-five dollars, and a still greater saving can be made by using one of the standard block condensers specially designed for this type of circuit. Careful laboratory tests have shown that while there is a slight increase in hum when the condenser capacity is cut down, this difference is so small that it cannot be detected by the human ear. These various factors have been taken into account when making up the list of approved apparatus and the various types of condensers that are suitable for use in the circuit have been listed.

The reason that a 41,000-ohm resistance is specified although part of it remains unused is because standard units of this resistance are available. They are tapped at the proper points. Fixed resistances have been specified at R1, R2 and R3 because the unit has been designed to work with the electric radio receiver of Blueprint No. 79. You can, of course, use this power amplifier and current supply unit with any type of radio receiver, if desired. If you have a battery set, disregard the 1½- and 2½-volt windings. The binding post marked P of the power unit should be wired to the P terminal of the first audio amplifier tube in your set, thus cutting out the second stage of audio amplification in your set. Do not attempt to use the complete two stage audio amplifier in your set with the power stage added to it. This combination is, in practically every case, absolutely unworkable.

Your battery operated receiver may require B-voltages differing from the electric set of Blueprint 79. If so, any desired B-voltages may be obtained by using at R1 a wire wound resistance unit fitted with clips that can be moved to change the voltage.

If any details of the construction, wiring or operation of the complete outfit are not clear, explain just what additional information you desire in a letter addressed: Radio Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York.

Toy Balloon Improves Blowpipe



A two-piece mouth blowpipe with balloon attached to insure a steady, even blast of air

WHEN you have work that requires the use of a mouth blowpipe, obtain one of the two-piece variety. Attach an ordinary ten-cent balloon to the large end with a rubber band, disjoint the blowpipe, inflate the balloon and reassemble the blowpipe. Then you will have a steady blast.—T. M. BRIDGES.

What Stations Can't You Get?

TRUVOLT
ALL-WIRE
RESISTANCES

Many fans find that by installing Truvolt Resistances in their circuits, reception is vastly improved and many more stations come in with ease.

This is because Truvolt Resistances give positive hairline control. Their scientific design with greater radiation surface keeps them far cooler, preventing variations in value and deterioration. A Full Line of Variable, Fixed and Tapped Wire Wound Resistances for all Radio Purposes.

Write for complete Free Resistance Circular

Dept. 64-F
175 Varick Street, New York, N. Y.

ELECTRAD, Inc.

SUPER QUALITY RADIO PARTS
Victoreen

A Super Set Using
VICTOREEN R. F. TRANSFORMERS

combines every requirement of a perfect radio set—selectivity, sensitivity, tone quality and stability. Victoreen R. F. Transformers are matched and tuned to a precision of ½ of one percent. They insure you of Super Set that cannot be surpassed.

#170 for Storage Battery Tubes
#171 for Dry Battery Tubes
$7.00 each

VICTOREEN
"112" Audio Transformers

The newest and most remarkable audio amplifier, combining the two stages in one unit, uses two "112" type tubes and up to 450 volts of "B" supply. Tone quality is marvelous.

Price $22.00

Write for Free Blueprints of the Victoreen Universal and the New Victoreen A. C. Circuit

The GEORGE W. WALKER Co.
MERCHANDISERS OF VICTOREEN RADIO PRODUCTS
2822 CHESTER AVENUE CLEVELAND OHIO

tested

Millions of Star Blades have been used by able mechanics

approved

Every year more mechanics choose Star—the blade known to them as "The Best"

FOLLOW the CROWD
You can't go wrong buying Star Blades

HEADQUARTERS *for* HACK SAW BLADES
Since 1883
CLEMSON BROTHERS, INC.
MIDDLETOWN, NEW YORK

Star Blades *Cover the World*

STAR HACK SAW BLADES

Ⓢ This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Home Movies

Easy to Take—Easy to Show

EXPERIENCE the great thrill of taking your *own* movies—movies of friends you love, of places you go—movies of your own dear children, filmed from life as they are today—romping, laughing, vital. See those precious pictures flash into life again in the magic of your own silver screen. Go to your camera store today. Learn how easy it is to make and show your own movies with a DeVry Home Movie Outfit—the product of fourteen years' experience in the manufacture of amateur motion picture equipment. Ask your dealer for a demonstration or write for free booklet. The DeVry Corporation, Dept. 3-PX, 1111 Center Street, Chicago, Illinois.

DeVry

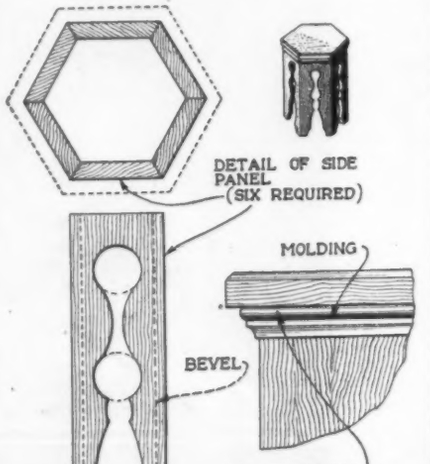
A Small Plant Stand Anyone Can Make

A SMALL ornamental plant stand of the type illustrated can be made easily by the amateur woodworker.

While stands of this type can be any size, one 14 in. high, 9½ in. across the top, and 8 in. across the base will be described. The wood is all ⅞ in. thick.

The core block, which goes just under the top, is inscribed in a 6¼-in. circle. Draw the circle and, using the same radius, step around it with the compasses and connect the points with straight lines. Then saw out the hexagon.

The six pieces that are to form the base may be beveled in one length and cut into sections that measure on the outside when finished ⅞ by 4 by 13⅛ in.



How the sides are cut out and assembled and the top is trimmed with a stock molding

Any suitable design may be cut out with compass, keyhole or fret saw. The one shown can be produced by boring two 2⅛-in. holes and cutting out the remaining parts with a small saw, but the work must be firmly held in a vise or with hand screws to prevent splitting.

To assemble the base, place one section in the vise, apply liquid glue of good quality, and attach another section with two or three small brads. Make three pairs in this way. Now, keeping the core block slightly below the top, glue and nail the parts lightly together. After the glue is hard, sandpaper the surface but do not round the edges.

The top is a hexagon inscribed in a 9½-in. circle and is either nailed or screwed from beneath the core block. A stock molding is fastened beneath the top. If an adjustable miter box is not available, a small miter block may be made for cutting the angles.

If the stand were made higher and somewhat larger, the core block might be lowered several inches and the top hinged, to make a lady's worktable.

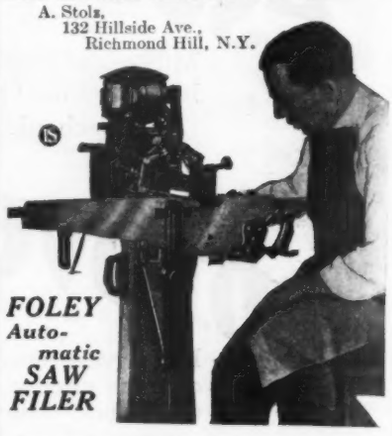
If made of hardwood, the stand can be stained and varnished or finished with clear brushing lacquer; if of softwood, it can be painted with colored brushing lacquer.—A. E. ELLING.

Out of Work-- Got a Foley--

Now Making Good Money!

"I lost my job on account of a strike. I took my last money and bought a Foley Saw Filer, and now I am making a comfortable living filing saws. Saws filed on the Foley cut truer, cleaner, easier and faster than hand-filed saws."

A. Stolz,
132 Hillside Ave.,
Richmond Hill, N.Y.



FOLEY Automatic SAW FILER

You can have a steady year around business of your own with a Foley. Be your own boss and make good money. File saws for carpenters, contractors, woodworking plants, factories, schools, farmers and homes. No canvassing. Just put the saw in the Foley and snap a switch. The Foley files and joints the saw automatically. More than twice as fast as hand filing. No eye strain. Saws cut faster, cleaner and truer. Build up a permanent business while at your present work and make $3.00 to $5.00 a day extra. We'll help you. Write for valuable plan on how to get into a money-making saw filing business of your own. No obligation. Address—

FOLEY SAW TOOL CO., Inc.
22 Foley Bldg., 9 Main St., N. E.,
MINNEAPOLIS, MINN.

PARKS
WOODWORKING MACHINES

Cabinet Shop Special No. 10 $290 with Motor

You ought to have this handy Parks in your shop. Compact, complete machine designed like a big production outfit at 1/5 the cost. Fits in a corner of your basement. Does any kind of cabinet or joinery work. *Write for circular.*

The Parks Woodworking Machine Co.
1547 Knowlton St., Cincinnati, Ohio
Canadian Factory: 208 Notre Dame East, Montreal

HB PAINT SPRAY
"DOES THE WORK OF FIVE MEN"

QUICK, EASY PROFITS! Practically no investment. Small space required. Steady demand and BIG PROFITS refinishing autos, furniture—painting houses and barns with HB quick spray method. One man does the work of five with brushes. Pays for itself on easy monthly payments. 30 DAYS' TRIAL. Write today for details.

EASY TERMS 30 DAYS TRIAL QUICKLY PAYS FOR ITSELF

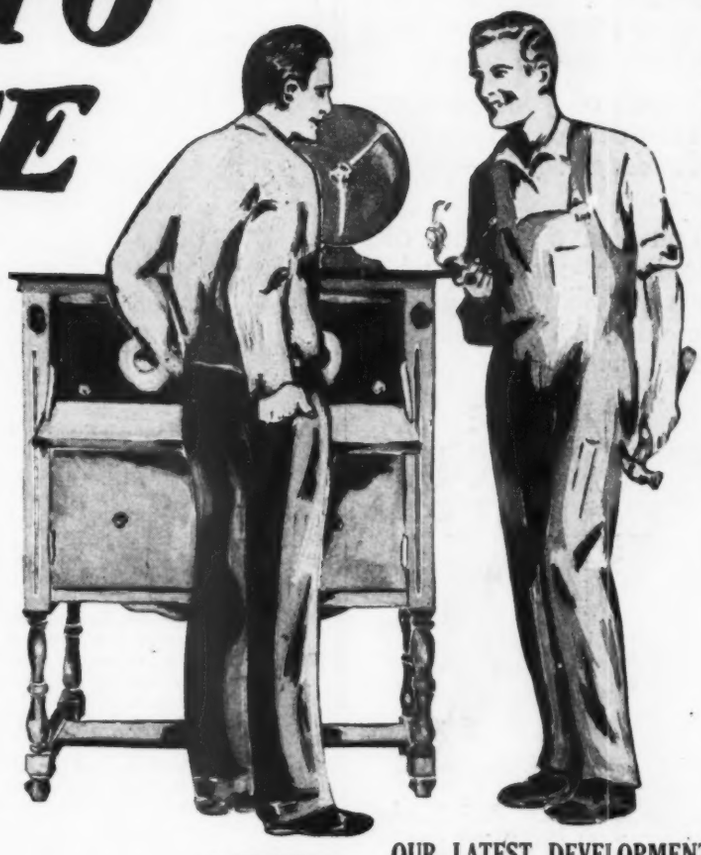
HOBART BROS. CO.
Box P381, Troy, Ohio

A definite program for getting ahead financially will be found on page four of this issue.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

I made it with my UP-TO DATE

A Real Shop That Makes Real Things



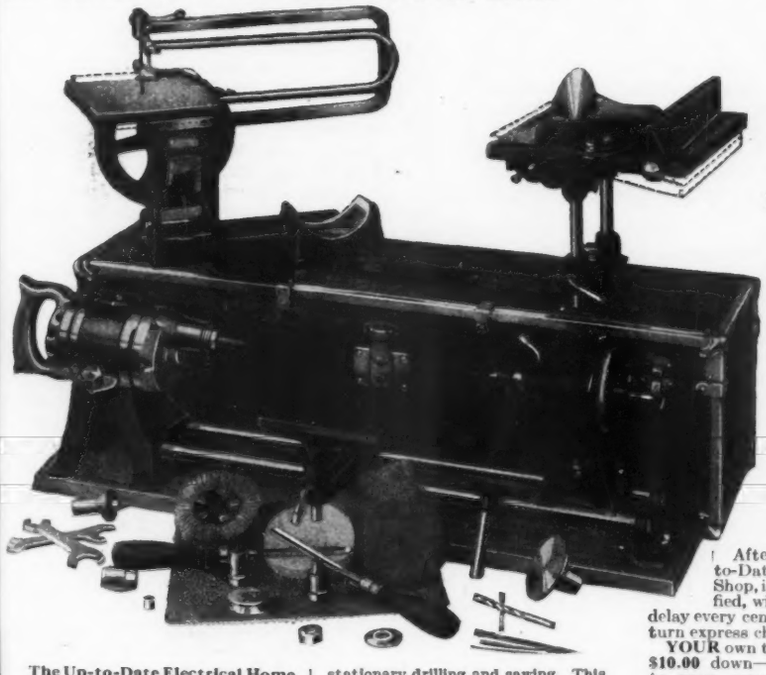
An Advanced Development in Home Craftsman Shop Equipment

You! Can make things too—Every man loves real equipment with which to build and repair things about the home and shop. Wood-work equipment was very expensive, large and bulky. Now, anyone can afford to own our Craftsman Shop. Cabinet-makers, Home Craftsmen, Carpenters, men who use only the best of equipments have praised this shop which is the result of perfection in design and precision. **"Make things the way they should be made, with tools that make them as they should be made."**

Notice the feature improvements on our equipment. A Tilting Table Circular Saw, with Miter, Side and Depth Gauge. A ½ Horse Power Universal Motor, a Tilting Table Jig Saw. A Heavier and more Precise Lathe, with a 10-inch swing and 34-inch turning capacity.

See and use this **Shop** at our expense. Take advantage of our **10-day free trial. Send for our literature. Mail the coupon below today.**

UP-TO-DATE HOME CRAFTSMAN SHOP



The Up-to-Date Electrical Home Craftsman Shop can be used in any home lighting fixture, thus making of your old-fashioned work bench a complete machine shop, made of a Super-power Motor, an accurate Lathe (10"x34"), a 6" circular saw, which features the bevel, miter, side and depth gauges, a Tilting Table, Jig Saw, and all accessories for buffing, grinding, cleaning and all portable or stationary drilling and sawing. This collection of electrically driven tools, complete in every detail, will make you an advanced craftsman. Master mechanics have designed and skilled engineers have constructed this equipment which, after inspection, you will agree is the best of its kind. For those who build, invent, create and construct at home, it is unexcelled.

OUR LITERATURE GIVES ALL DETAILS

ONLY $10 DOWN

OUR EDUCATIONAL AND BLUE PRINT DEPARTMENTS

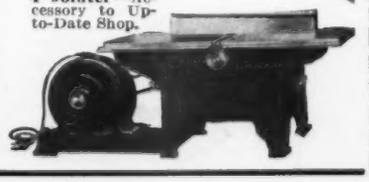
Under personal supervision of Master Craftsman Eugene E. Maurey, offers special correspondence crafts course, giving in simple detail full information on home handicraft. Blue print service giving plans and details for making hundreds of pieces of wood handicraft included in this course FREE to our users.

GUARANTEE

After receipt of the Up-to-Date Home-Craftsman's Shop, if you are not satisfied, without question or delay every cent refunded and return express charges paid.

YOUR own terms on purchase. **$10.00** down—balance arranged to your convenience. Liberal discount for cash.

4" Jointer—Accessory to Up-to-Date Shop.



OUR LATEST DEVELOPMENTS

The New 12" Band Saw

Our latest development—a 12" hand saw, operated with the regular Up-to-Date Motor. This saw has a tilting table, a miter and side and depth gauge. Send for details.

INDIVIDUAL HEADSTOCK

Furnished where no electricity is available or to operate from an individual motor, gasoline engine, or line shaft. Note circular saw and lathe arrangement.

10 DAY FREE TRIAL

Use our shop for 10 days at our expense. If not satisfied—return—express collect.

MAIL THIS

for full particulars to

Up-to-Date Machine Works

2915 S. Wabash Ave., Chicago, Ill.

MANAGER. Dept. 1. Without any obligation, please send me all particulars about your shop, 10-day free trial, free blue prints, free crafts course, also $10.00 down payment offer.

NAME.....

ADDRESS.....

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

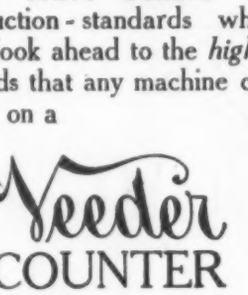
Announcer of Features that Count

As fast as you improve a machine or method of operating, a *VEEDER* announces the outcome—*in output.*

It reels off your progress in new developments, in terms of *added production*—per day or hour.

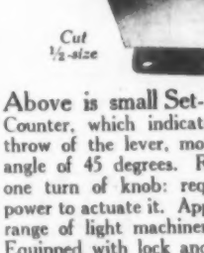
You leave behind old production-standards when you look ahead to the *higher* records that any machine can make on a

Veeder COUNTER



Above is small Set-Back Ratchet Counter, which indicates one for each throw of the lever, moving through an angle of 45 degrees. Reset to zero by one turn of knob: requires very little power to actuate it. Applicable to a wide range of light machinery. Price, $6.00. Equipped with lock and key to prevent tampering with the record, $2.00 extra. Also furnished in a Revolution Counter.

The small Revolution Counter below registers one for a revolution of a shaft, recording a machine operation, or product. Though small, this counter is very durable; its mechanism will stand a very high rate of speed, making it especially suitable for light, fast-running machines and most adaptable to experimental work. If run backward the counter subtracts. Price $2.00. (***Cut 4/5 size.***)



Small Rotary Ratchet Counter, to register reciprocating movements of small machines, also $2.00.

The Veeder booklet shows instruments that "count everything on earth." See them—by sending for the book.

The Veeder Mfg. Co.
44 Sargeant St. Hartford, Conn.

How to Lay Out Your Shop

(Continued from page 92)

vise mounted on it. As the vise is also used for many filing operations, wire drawing, and many other things, the height of the jaws from the floor should be carefully considered.

The six legs are made of 4 by 4 in. lumber; the rest of the framework may be made of from 1 to 1¼ in. thick boards, 6 or 8 in. wide. If the bench is to be a short one, say 3 or 4 ft. long, four legs will be enough. The top should be of hardwood, beech or maple if possible, and 2 in., or at least 1½ in. thick.

A strong bench will result if it is simply nailed together with heavy spikes; or the frame may be bolted together, the top being held with countersunk lag screws. If you are fond of woodworking you may make the whole affair with mortise and tenon joints, but it is not at all necessary.

Each of the legs is firmly fastened to the floor with angle irons, and the bench should be also held firmly to the wall with angle irons, if possible.

The planks forming the top should be fitted together as tightly as possible and planed smooth. When the bench is finished, the top should be given one or two coats of boiled oil, and the framework painted some attractive color.

The leg of the blacksmith's box vise extends into a hole in a block of wood firmly fastened to the bench leg and floor. The vise should be fastened to the bench top with heavy bolts, the front edge of the bench being notched out, if necessary, to receive a part of the back leg of the vise. A bench drill is a useful tool to have on this bench.

Notice that the shop layout is planned so that there is room between the two benches; one may work at the end of the vise, standing between the two benches, as one often finds it convenient to do when engaged in hammering out bowls and trays.

The advantage of a blacksmith's vise is that it is made of wrought steel and is very strong. Considerable pressure must be put on vise jaws to hold a stake firmly under repeated hammer blows, and the more finely made machinists' vises, while they may be used, will not usually stand up under the work, being made of cast steel or iron. There are many other uses for a heavy vise in the shop as will be noted later on.

THE heavier the vise is, the better. The one which I use has jaws 6 in. wide, and the whole vise weighs about 120 pounds. I have had and used it for longer than twenty years, and we have tackled some heavy jobs together.

Vises are usually sold and listed by the width of the jaws (parallel with the handle). If you buy a vise of the blacksmith's type, get one with at least 4-in. jaws; one with 5-in. jaws is better, and one with 6-in. jaws best of all. This kind of vise, if not sold by your hardware dealer, can be obtained reasonably from any of the large general mail order houses.

Of course, if you already have a machinist's vise of good size, you may use this, or devise some other method of holding the stakes as shown in Fig. 2. At A is a tinsmith's bench plate such as you may have seen in a tinner's or coppersmith's shop. This is a heavy slotted iron plate with a number of rectangular holes or slots. It is let into the bench top, and the wood underneath each slot is cut out to correspond with the taper of these slots, so that the tapering ends of the stakes or anvils are held very firmly. This is a very old and satisfactory method of holding stakes. Bench plates of this sort may be obtained from dealers in tinsmiths' supplies. It is well to get the catalog of such a firm, as you will find many stakes, anvils and other special tools for the use of metal workers.

Another method of holding stakes is shown at B. It is perhaps the oldest and best method of all, if you have room for it. A large log or stump of hardwood—maple or beech—is fastened to the floor of the shop with angle irons. In the top of this log, which is about 30 in. up from the floor, is cut one or several tapering slots to fit the tapered ends of the stakes and hold them firmly for hammer work. This is the most noiseless and inexpensive way of holding stakes for making bowls and trays. Many metal workers who live in the country have several of the logs set in the ground in some pleasant location outside the shop, where they work in the summer. Shallow hollows may also be carved in the top of the logs for embossing bowls, forming spoons and so on.

At C is shown the common method of holding stakes or anvils in a heavy vise. This method has the one advantage of allowing the worker to tip his stakes at various angles to suit the work.

Iron pipe or steel bars of different lengths and diameters may also be held in the vise and used as anvils or stakes. You will find a collection of short lengths of pipe and round or square steel bars from the junk yard extremely useful.

A regular stake holder mounted on the bench top is shown at D, Fig. 2. These holders are often sold with sets of stakes. A piece of thin leather slipped between the stake and the holder tends to make the stake hold more firmly and lessens the noise somewhat.

RETURNING to Fig. 1, you will see a rack for stakes back of the bench for heavy work and just under the window. If the stakes are to be hung on a flat surface, such as in a closet or on a wooden wall, heavy harness hooks form excellent holders, two being used for each stake, just as a hammer is hung on two nails. Another excellent method of holding stakes is to screw a length of old leather or rubber belting, about 1½ in. wide, to the wall so that loops are formed. Metal washers should be placed under each screw head.

On the bench for heavy work is a small bench anvil. An old flatiron with the handle broken off makes an excellent substitute.

Between the benches for heavy and light work, mounted on the wall, is a pair of large bench shears for cutting heavy sheet metal. The end of the lower handle or leg may be set in a slot in the bench top or bench plate or held in the vise. Above the bench shears is a large pair of hand shears or tinner's snips.

Two wooden mallets also will be seen. One is an ordinary wooden mallet of hardwood, one face being flat and the other dome shape or round for embossing or raising. The other mallet, or raising hammer, is square in section and tapered to a blunt point at one end. This form is much used in the preliminary stages of raising certain types of copper bowls and trays.

It is worth remembering that wooden tools are much used by the professional metal worker, as they leave no marks that may not be easily removed or worked out later on.

Above the mallets are mounted special forms of silversmiths' or coppersmiths' hammers for embossed and raised work.

The bench for light work or jewelry making should be built solidly, although it is of much lighter construction than the other bench. Suitable dimensions were given in an illustration that accompanied the first article in this series, but the size can be varied to suit the shop space. The

(Continued on page 123)

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 3.

How to Lay Out Your Shop

(*Continued from page 122*)

height from the floor to the bench top is planned to suit the convenience of the worker when seated at the bench—usually between 29 and 31 in.

THE four legs may be made of 2 by 4 in. lumber, the other members of the frame being 1 by 6 or 1 by 8 in. boards. The top preferably should be of hardwood such as maple or beech, 2 in. thick. A semicircular piece is usually cut out of the front edge of the bench top, about 5 in. deep and 16 in. long. This allows the bench pin, described last month, to be mounted, as shown, conveniently over a leather apron or "skin," which catches silver or gold filings. Sometimes a zinc-lined drawer is arranged to slide in and out under the bench pin to catch filings, but many jewelry makers prefer the leather skin. This may be of genuine leather or one of the durable, smooth leather substitutes used for chair or automobile cushions. Small hooks are arranged under the bench so that the skin will hang baglike under the bench pin and yet not interfere with sawing the work.

On top of the bench at the left are two gas connections (cocks with rubber hose attachments), one being connected to a Bunsen burner and the other to a mouth or "combined" blowpipe. If you have no gas in your shop, you may use an alcohol chafing dish lamp instead of a Bunsen burner and an alcohol blowtorch in place of the gas blowpipe, as I do in my own shop.

A very small pair of jeweler's snips or shears is hung on the front right leg of the bench. It is a good plan to have a small bench vise of the demountable kind, which may be clamped to the front edge of the bench when needed.

The tool rack at the back of the bench is simply a piece of soft wood ¾ in. thick, 2 or 3 in. wide and as long as the bench. Slots are made in it for files, and holes are made for the other small tools such as scriber, dividers, pliers, and tweezers. When the bench is finished, the top should be oiled and the underpart painted.

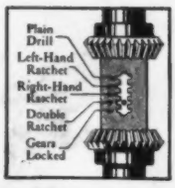
The foot power polishing machine, also described last month, is shown on the extreme right. On the wall back of it are hung the various emery wheels, polishing and buffing wheels, and wire scratch brushes. The polishing machine should have a good working light.

ALTHOUGH not shown, or absolutely necessary, a blacksmith's anvil weighing from 75 to 150 lbs., solidly mounted on a heavy wooden block, is useful. Such anvils are best mounted on a heavy section of a tree trunk, the lower part of which is sunk solidly in the floor, if the floor is of earth as in most blacksmiths' shops. If this is not possible, the anvil block should be held to the floor with heavy angle irons. A skilled metal worker can make almost anything on such an anvil.

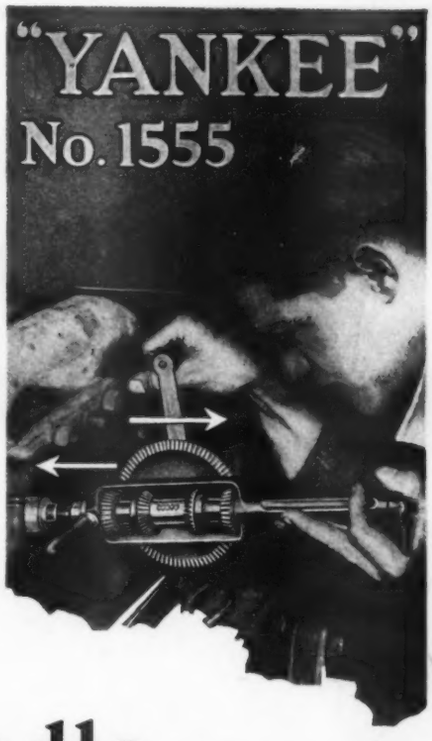
If you cannot manage to have a real blacksmith's anvil, you may care to invest a few dollars in one of the very reasonably priced cast steel farm anvils sold by hardware dealers and mail order houses. These cast anvils range from 50 to 100 lbs.

If your shop is a small one, you may get along perfectly well with an improvised flatiron for an anvil, or a small bench anvil and pipe or steel bars held in the vise. If you really want to do a thing badly enough, you will manage it somehow. In metal working or any other craft, the secret is to know just what you want to do and how to do it; then you may improvise many ways of doing it and adapt the tools of one trade to another, as you will see further along in this series.

The fourth article in Mr. Thatcher's series will appear in a forthcoming issue.



A finger touch on Ratchet Shifter gives any one of five adjustments.



Drilling out broken stud bolt in valve cover. This ingenious "Yankee" Drill does what others can't—and saves time and labor.

Handle *goes back* –but drill *advances*

LACK of room to turn the crank doesn't matter—when you use "Yankee" Ratchet Breast Drill No. 1555. For, when set on DOUBLE Ratchet, any slight movement of the crank, either back or forth, lets you drill continuously.

You get speed with accuracy—because you can feel your work, control it, and know what you are doing all the time. Nothing need be removed. No lost time. No lost motion.

The five ratchet adjustments shown above, and two speeds, make this ingenious "Yankee" the handiest and fastest breast drill ever designed.

No. 1555 "Yankee" Ratchet Breast Drill Price, $11.00

Speeds can be changed instantly without removing drill from work. Just shift lever at base of hub.

Ratchet Breast Drill No. 1555 (Illustrated), 3-jaw; No. 555, 2-jaw. Hold ½ in. Drills. Ratchet Hand Drill No. 1545, 3-jaw; No. 545, 2-jaw. Hold ⅜ in.

For smaller drilling jobs use "Yankee" Ratchet Hand Drill No. 1530, with five ratchet adjustments.

Write for Free "Yankee" Tool Book

Shows how "Yankee" Tools make work easier: Spiral Screw-drivers, Plain Screw-drivers, Ratchet Bit Braces, Automatic Push Drills, Automatic Feed Bench Drills, Ratchet Tap Wrenches, Vises with removable base, etc.

Dealers Everywhere Sell "Yankee" Tools

"Yankee" on the tool you buy means the utmost in quality, efficiency and durability.

"YANKEE" Ratchet Tap Wrench No. 250

Makes awkward jobs easy. Where complete turn cannot be made, simply pull out sliding cross-bar to end position. Right and left ratchet and rigid adjustments. Price $1.85.

NORTH BROS. MFG. CO., Philadelphia, U. S. A.

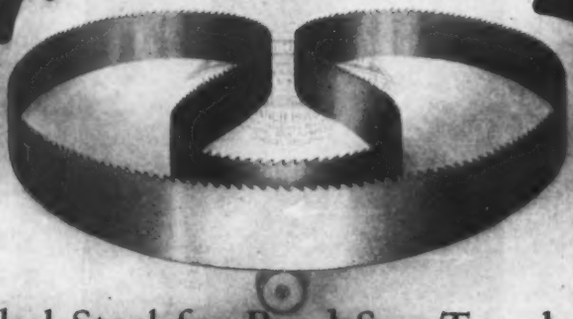
"YANKEE" TOOLS

Make Better Mechanics

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

SIMONDS

SAWS FILES KNIVES STEEL



Nickel Steel for Band Saw Toughness

SIMONDS Band Saws are made of a special alloy steel to insure greater toughness, strength, and improved wearing qualities. They will hold their tension longer, stand more feed, and do more work, than other saws that cost just as much. Specify Simonds for economy!

SIMONDS SAW AND STEEL COMPANY

"The Saw Makers" Fitchburg, Mass. *Established 1832*

BRANCH OFFICES AND SERVICE SHOPS IN PRINCIPAL CITIES

"Takes only a minute—lasts all day"

Toothbrush — razor — *Stacomb*. All part of getting ready for a successful business day.

Men of affairs rely on Stacomb to give just the right set to their hair. To keep it smooth, orderly—*all day long*. To counteract dandruff, too (Stacomb supplies needed oils to the hair—whereas water dries out the scalp). Try Stacomb yourself—free.

NEW LIQUID *Stacomb*

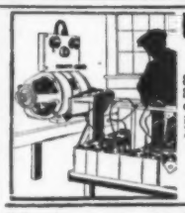
Reg. U. S. Pat. Off.

Standard Laboratories, Inc.
Dept. R-2, 113 W. 18th St., New York

FREE Send me sample of Stacomb as checked: New liquid form ☐ Cream form ☐

Name .....

Address .....



HB ONE DAY BATTERY CHARGING

Pays $150 to $300 Monthly Profits

Start your own big business now. Small payment brings complete outfit for recharging auto and radio batteries. Easy terms. Moneyback guarantee. Write to HOBART BROS. CO. Box P38, Troy, Ohio

ONLY $16.50 MONTHLY

If you want financial independence read the story "How a Big Load Was Lifted from Harry Wilson's Mind," on page four of this issue.

We Pay Freight

$796 Buy Direct Save $200 to $1500

Beautiful 6-room home with porch

Mrs. Coombs saved $1000, B. A. Anderson saved $500. F. E. Davis saved between $1000 and $1500 by building the Liberty way. You can do as well. No waste. No worry. 40% less labor. Substantial, permanent homes. Write today for full information.

FREE Beautiful New Book of Liberty Homes

Pictures wonderful homes from $379 to $1483. Price includes all lumber cut-to-fit, millwork, roofing, lath, hardware, paints, nails. Materials fully guaranteed. Plans FREE. Freight paid east of Mississippi River and north of Mason-Dixon line, also to Minnesota, Iowa, Missouri. *Costs Nothing to Find Out—Write For Catalog Now.*

LEWIS MFG. CO., Dept. 13C, Bay City, Mich.

The Exterior Setting

(Continued from page 94)

on brackets. The window has shutters made useless by overhanging rose vines in bloom. In back, at right angles to the wing of the house, the garden is bounded by a clipped hedge with irregular flower planting set against it; and just before the hedge encounters the left boundary of the stage, a rose arch and a gate mark the entrance to the garden. Beyond this hedge and gate one gets a view of meadows with trees and a glimpse of distant houses. On the left of the stage and opposite the door into the house is a garden seat with an awning top; in front of this seat are a table and a chair. A rose lattice showing a profusion of blossoms is in back of the seat; it is high enough and wide enough to screen and shut from view the adjoining orchard.

SO MUCH for the written description. Now let us make a rough sketch plan—just a few hastily drawn lines to indicate the general arrangement. The essential elements of the setting are indicated at *A* in the lower illustration on page 94; they are shown rearranged at *B* with the idea of making a better stage picture. For the sake of the composition I have added a tree at the corner of the house.

Next it is desirable to make a rough perspective sketch. If this seems to satisfy the requirements of the script, we had best draw a plan accurately to scale and from this plan work up the stage model.

The making of a model of an exterior set will call for a little more painstaking attention than is needed in the construction of an interior set such as that described in a previous article (December, 1927, issue). As the various elements of the setting are individual pieces, they will have to be set up separately instead of in the self-supporting continuous strip that forms the side of a model of a room interior. In locating the elements, make sure they are placed so that they will inclose the entire scene and, when viewed through the proscenium arch, leave no gaps and openings into the back stage. This is an important function of the model. When the inclosure has been worked out in the model, the scenewright can rest assured that his actual set will be "eye-tight," provided the stage model is accurately enlarged.

In painting an exterior set it is always best to handle the work in a free, decorative way. Even at the best the outdoor setting is a convention. It can never look as convincing as an interior, but the audience is always ready to accept a compromise between nature and art, especially the art of an amateur. The best that the scenewright can hope for is to *suggest* the out-of-doors. And for this reason he is perfectly justified in giving the set a posterlike simplicity, showing his tree forms in frankly angular outlines, and painting his foliage in mass rather than in detail.

IN THE actual construction of the exterior setting I find that building paper is again a useful economy. On page 94 are shown the backs of two cut-out tree forms. The same method can be used for the frame of a hedge. For work of this sort it is often better to double the thickness of the paper, or use an extra heavy building paper.

In designing a set the scenewright must keep in mind a plan for lighting it. In the problem which we have been discussing the back drop can be lighted from the line of the hedge; the tree at the corner of the house will lend its upper branches for the concealment of these lights; and the hedge itself will serve to hide a string of floor lights.

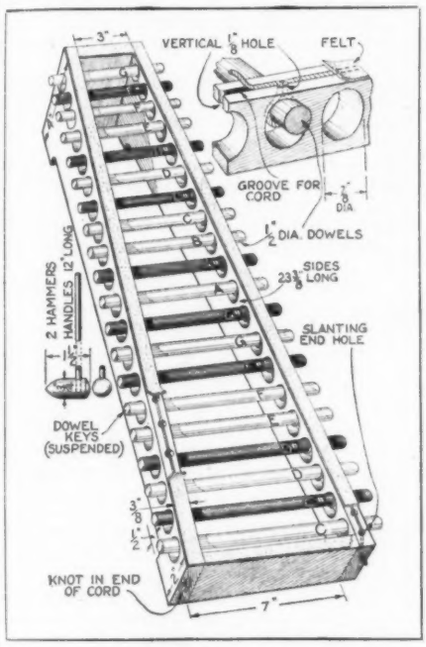
The scenewright must realize that in an exterior setting the lighting will be his chief aid to the illusion of space. He must plan for it from the start. If it has been properly worked out his setting will come to life.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Dowel Sticks Serve as Xylophone Keys

THE music of the xylophone in either solo or ensemble playing has a piquant quality that makes the time spent in learning to play it well worth while. First it is necessary to obtain an instrument on which to practice, but that is not difficult. Any handy man can make a satisfactory xylophone of the type illustrated. It has a chromatic range from C to G of the octave above, inclusive.

Any kind of wood may be used for the box. The keys are made of dowels. Make two sides ⅜ by 4 in. (tapered to 2 in. at one end) by 23⅜ in.; one end ⅜ by 2 by 7 in. and one end ⅜ by 4 by 3 in. Bevel



The assembled xylophone and details of the hammers and the method of supporting keys

the ends of each of the short pieces slightly to join the sides neatly.

On a line ⅝ in. from the top edge bore twenty ⅜-in. holes, 1⅛ in. from center to center. In doing this place the sides under pressure in a vise or hand screw to prevent splitting. Use a center or a Forstner bit.

Drill a ⅛-in. hole in the top edge vertically above the center of each large hole and a slanting hole at each end. Assemble the box with 1¼-in. brads.

Make the keys of ½-in. dowels, maple preferred; cut them somewhat longer than required. Tune with a piano or other instrument of permanent pitch, beginning with the lowest note. Make a key sharp by cutting from the end, or flat by putting a saw cut in it. Stain the sharp keys with black ink or dye, but use neither shellac nor wax. Cut a groove in the upper edge of each side piece to receive the cord.

The heads of the hammers may be made of a ¾-in. dowel and the handles of a 5/16-in. dowel.

Stain and finish the box as desired, or not at all, but do not touch the top edges of the sides with oil or wax, for the last thing to do is to glue on a piece of felt to cover the cord.—C. A. K.

Millions *can't be* Wrong

Join this Multitude of Happy Shavers—but Don't Switch till You Let this 10-day Test at our Expense Prove Our Case to You

GENTLEMEN:

Rarely is a new product received with such acclaim as has greeted Palmolive Shaving Cream.

Literally millions who have tried it have been won from lesser methods. Most of them accepted our invitation to shave ten days "on us" before they made a switch.

That test does the business. That settles all doubt. After ten days of perfect shaves very few ever return to old methods. Won't you, too, give us a chance to prove what we have done for you? Just mail the coupon for your free test.

The 130th Formula Won

Palmolive Shaving Cream is a triumph of one of the world's greatest soap laboratories. Sixty-five years' experience stand behind that name.

When we first set out we sought the advice of 1000 men on what they thought a shaving cream should be. They told us four things—we added the fifth. But not until formula after formula had failed to satisfy in one way or another.

After 129 formulas were tested and rejected came the shaving delight you'll know when you get *your* free tube.

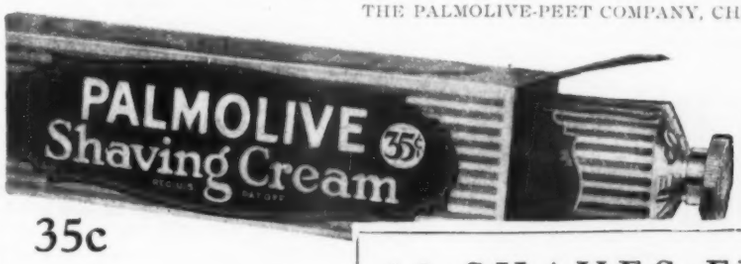
5 Remarkable Features

1. Multiplies itself in lather 250 times.
2. Softens the beard in one minute.
3. Maintains its creamy fullness for 10 minutes on the face.
4. Strong bubbles hold the hairs erect for cutting.
5. Fine after-effects due to palm and olive oil content.

Now Send the Coupon, Please

We take the risk—not you. We undertake to please you . . . to win you in ten shaves. The coupon is for your convenience. Won't you use it, please?

THE PALMOLIVE-PEET COMPANY, CHICAGO, ILL.



35c

To add the final touch to shaving luxury, we have created Palmolive After Shaving Talc—especially for men. Doesn't show. Leaves the skin smooth and fresh, and gives that well-groomed look. Try the sample we are sending free with the tube of Shaving Cream. There are new delights here for every man. Please let us prove them to you. Clip the coupon now.

3884

10 SHAVES FREE

and a can of Palmolive After Shaving Talc

Simply insert your name and address and mail to Dept. B-1458, Palmolive, 3702 Iron St., Chicago, Ill. Residents of Wisconsin should address Palmolive, Milwaukee, Wis.

.....

.....

(Please print your name and address)

Radio • Is • BETTER • With • Dry • Battery • Power

You can candle an *egg*-but not a *battery*

THERE isn't much difference in the size or shape of batteries. And you can't tell how good they are before you use them. ¶ If you could, one element alone would win your preference for Burgess. That element is *Chrome*. ¶ *Chrome* is the *preservative* that maintains an abundance of unfailing energy in Burgess Batteries—long after most dry cells cease to function. The black and white stripes are individual marks for identifying Burgess *Chrome* Batteries. Buy them for long lasting, dependable performance!

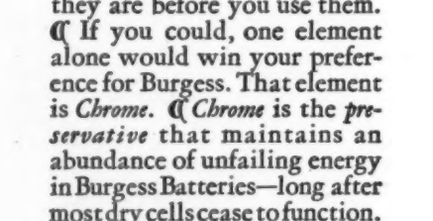
Chrome—the preserving element used in leather, metals, paints and other materials subject to wear, is also used in Burgess Batteries. It gives them unusual *staying* power. Burgess *Chrome* Batteries are patented.

Ask Any Radio Engineer

BURGESS BATTERY COMPANY

General Sales Office: CHICAGO

Canadian Factories and Offices:
Niagara Falls and Winnipeg



BURGESS
FLASHLIGHT & RADIO
BATTERIES

How to Care for Your Tools

(*Continued from page 86*)

with a try-square, which would be slower.

The edge of a chisel should be ground square across as at *D*. A jack plane or a single-iron plane for rough work should be well rounded as at *E*, while the edges of a smoothing plane iron or of a spokeshave iron should be shaped about like *F*. The edge of the jointer plane should be slightly elliptical as in *G*. In all the sketches the curves are somewhat exaggerated.

Assuming that the edge of the grinding wheel is perfectly straight and true, the edge of the cutter should be carried squarely across as at *H*, the wheel always turning toward the edge. Keep the tool moving from right to left. Grind until the cutter is in its correct relation to the edge of the cap iron and a wire edge may be seen the entire width of the tool.

Grinding is only preparatory to whetting or oilstoning. Use lard oil or a light lubricating oil on the oilstone. Draw the cap iron back to the top end of the groove in the cutter and fasten it, as at *J*. Grasp the iron and cap in both hands as at *K*; place it across the stone at

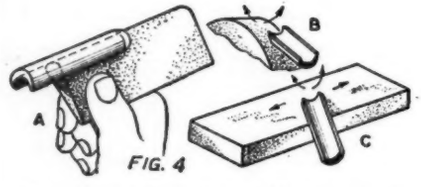


FIG. 4

Gouges beveled on the outside are ground and whetted by turning the hand continually; the wire edge is removed with a slip stone

an angle of about 30 degrees and raise or lower it as at *L* until the exact bevel is attained either by feeling or by seeing the oil that is squeezed out when the cutter is properly placed. Maintain this angle, carrying the tool back and forth the entire length of the stone. Guard against the tendency of the tool to "rock," which rounds the edge and destroys the bevel. Carrying the iron as at *K* should largely prevent this, but if it does not the worker will be justified in making circles and figure eights instead of straight motions.

When the beveled side has been whetted from fifteen to twenty-five strokes, the wire edge may be removed by a few strokes with the face of the cutter lying *flat*, in *perfect contact* with the stone as at *M*. Pressure is applied in the direction indicated by the arrows.

The cause of a clogged plane mouth, usually is a badly fitting cap iron as at *N*. Hold the cutter and cap so light may be seen through the faulty joint between them as at *O*. A very bad place may be remedied by bending, but the final fitting should be done with a flat file as at *P*.

Perhaps the top side of the cap edge may have become rounded by long use as at *R*, in which case it should be bent back and filed to the same curve as a new cap iron. Be sure that the edge is kept square with the sides. Note that the file at *P* slants *down* to make a thin edge. Place the cutter and the cap iron in position as at *S* and with the corner of a chisel press firmly against the outside of the joint, which will force the particles of steel into perfect contact with the face of the cutter.

In sharpening gouges the slip stone should be used, but unless used correctly with the hand well away from the cutting edge as at *A*, Fig. 4, an ugly cut may be received. Outside gouges may be ground on a grinding wheel by turning the hand as at *B* and whetted by the same method as at *C*.

The scraper prepares a planed surface for the sandpaper by removing the minute ridges between plane strokes; it also supplements

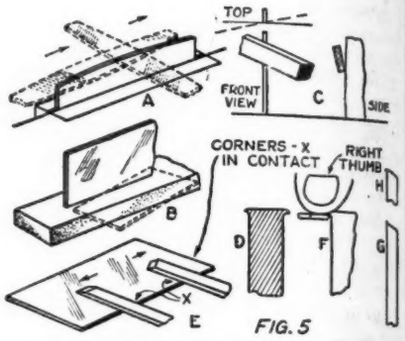


FIG. 5

A cabinet scraper is sharpened square across and the corners are then turned over a trifle

the plane in smoothing cross-grained places. The sharpening of a scraper is a knack to be acquired by practice. Place the scraper in a vise and file the edges square across and slightly rounding lengthwise as at *A*, Fig. 5. Hold the file either lengthwise or crosswise, but move it in the direction indicated. Whet each edge to two sharp, square corners as at *B*. Apply a little oil and hold the scraper as at *C*. The edge of a burnisher or the corner of a chisel is placed in contact with the edge of the scraper as shown. Point the burnisher or chisel *down*, keep it square with the edge, and make one light, firm stroke upward. Begin at the bottom and make a heavier stroke. Keep the angles shown exactly the same except in one respect; push the burnishing tool with the thumb in such a way as to incline it as shown by the dotted line. This will turn the corner or edge of the scraper as in the enlarged view *D*. All four corners may be sharpened.

IF THE scraper has been sharpened successfully it should cut a thin, clean shaving as wide as the worker has strength or skill to produce, but if a powder is *scraped*, the sharpening has been a failure. This may be the case if the edge has been turned over too much or because it has become dull. In either case it may be remedied by laying the scraper flat on the bench and rubbing the edge down as at *E*. Carry the burnisher at each stroke on the corner marked *X*. Then repeat the process of turning the edge.

If the edge has been turned too far the defect may often be remedied by carrying the burnisher the length of the scraper, under the edge and against the thumb as at *F*, then giving one light stroke as at *C*.

If a scraper is well rounded on an edge or end and file-sharpened at a bevel as at *G*, it will scrape paint effectively. If whetted and the edge turned over as at *H* it will do more satisfactory work upon floor scraping and similar rough work than the square-edge scraper.

In sharpening an auger bit, the underside of the cutter (*A*, Fig. 6) should not be touched. The filing should be done upon the top of the cutter with a special bit file as at *B;* this file has smooth edges at one end so that lip *C* may be filed as shown at *D*. Do not file the outside of the lips.

(*Continued on page 127*)

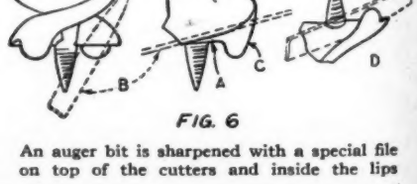


FIG. 6

An auger bit is sharpened with a special file on top of the cutters and inside the lips

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

How to Care for Tools

(Continued from page 126)

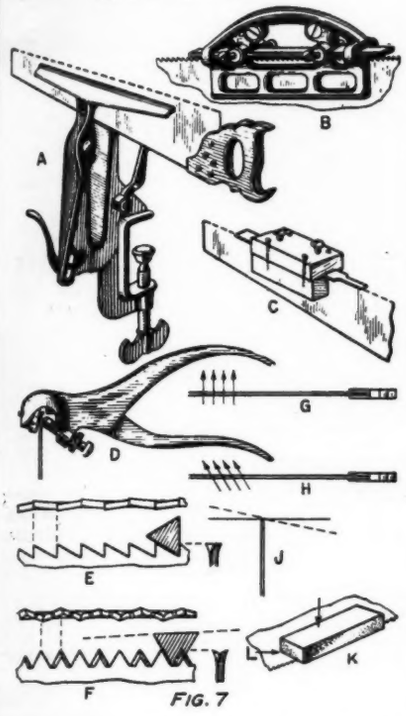


FIG. 7

How the teeth of a rip saw (*E*) and a crosscut saw (*F*) are "jointed," set and filed sharp

The average home worker had better sidestep saw filing unless he can practice upon a saw of no great value. We will assume, however, that our readers wish to go the whole distance. Place the saw in a saw filing vise as at *A*, Fig. 7. With a flat file held in a jointing device take one or two strokes lengthwise to "joint" the saw, or to make the teeth of uniform length, as at *B*. A jointer may be made of wood as at *C*, though many workmen use the file free-hand. With a saw set *D* bend out alternate teeth for one third of their length from the point; then do the same from the other side. At this stage a rip saw should appear as at *E* and a crosscut saw as at *F*.

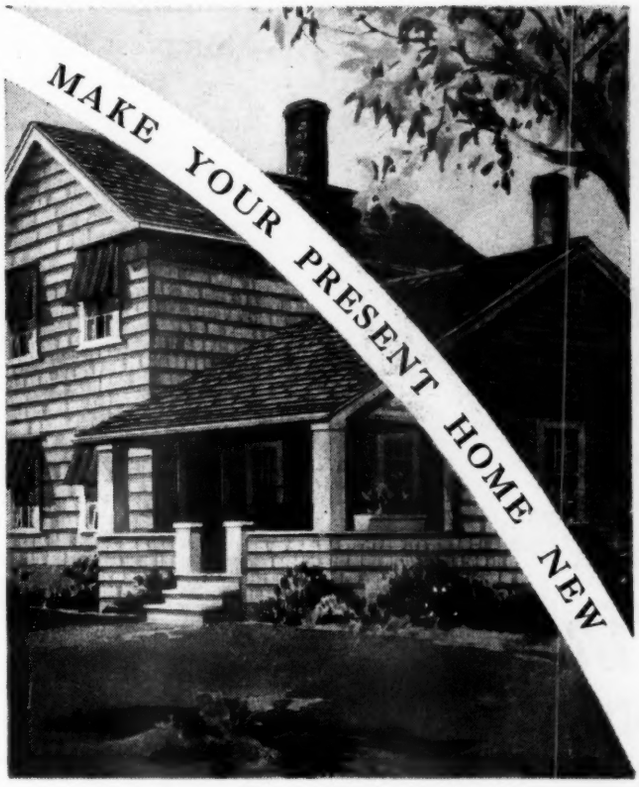
In filing a rip saw begin at the point and file every tooth square across, carrying the file at right angles as at *G*. Hold the file so the side which is filing the front of the tooth behind it stands vertical as at *E*. The amateur may find it easier to file a rip saw from each side, filing the teeth that are set away.

In filing a crosscut or cutting-off saw the file should be carried at an angle pointing toward the end of the saw of about 60 degrees with the saw blade as at *H* for a general purpose saw, rather less if for soft wood only. Many mechanics, however, point the file toward the handle.

THE file should be carried as at *F* to give each tooth "hook," which is a large factor of the "sweetness" of the cut.

The writer prefers to carry the file level as at *J*, although many prefer to lower the hand a little as shown by the dotted line. This applies to cutting-off saws and rip saws if filed from both sides, but in every case the teeth should be of uniform length. This may be attained by watching the glint of light on the end of the teeth where they were touched by the file when jointing them. Remove about half of the glint from each tooth from the first side and the rest from the other side.

Lay the saw upon a perfectly flat surface and carry a flat file or whetstone from handle to point over the teeth to remove the burr. Keep the pressure as at *K* so the stone will bear a little harder at the edge marked *L*.



Save paint and fuel

with Creo-Dipts over old siding

YOU don't have to build a new house to have a beautiful, modern home! Lay Creo-Dipt Stained Shingles right over the present side-walls!

The cost is only a little more than two thorough repaintings—once up, the Creo-Dipts require very little care. In 5 to 7 years—the actual savings more than pay for the Creo-Dipts and labor.

The Creo-Dipts save fuel—most owners estimate 15% to 25%—because they add an entire new coat of insulation against winter cold and summer heat.

The Creo-Dipts save paint because Creo-Dipts are selected, straight-grained cedar shingles, weatherproofed in advance by exclusive Creo-Dipt processes. Their colors grow more pleasing with age.

See in advance how your home would look with old side-walls and roof covered with Creo-Dipts.

28 interesting photographs

Send for "before and after" photographs showing other old homes rebeautified in this same way.

See how leading architects are using Creo-Dipt Stained Shingles for all types and sizes of new houses. Mail the coupon now for 28 interesting pictures—many of them reproduced in full colors.

Genuine Creo-Dipts are carried in stock by leading lumber dealers everywhere; for 20 years, prominent architects and builders have endorsed them. Look for the name *Creo-Dipt* on each bundle—it is placed there for your protection.

SEND FOR PHOTOS

CREO-DIPT
Stained Shingles

Creo-Dipt Co., Inc., 1330 Oliver St., No. Tonawanda, N. Y. (In Canada: Creo-Dipt Co., Ltd., 1610 Royal Bank Bldg., Toronto.) Sales offices in principal cities.

Enclosed find 25c for twenty-eight large-size photographs of new Creo-Dipt homes by leading architects, "before and after" pictures of old homes rebeautified, booklet of color suggestions, and name of local Creo-Dipt dealer who will recommend a reliable carpenter-contractor.

☐ Covering siding ☐ Covering stucco

☐ Building new ☐ Re-roofing

Name..... *Address*.....

© C-D Co., Inc., 1928

Sit in with your favorite orchestra

Wonderful teacher—the phonograph! First it taught us to love good music. Now it is teaching us to play. You can acquire a master style by studying your favorite records with your

BUESCHER

True Tone Saxophone

You have a natural desire to personally produce music. Don't starve that desire. Develop it. We recommend starting with a Buescher Saxophone because it is the easiest of all instruments to learn to play and its music is the most beautiful.

You Can Teach Yourself

If you can whistle a tune, if you can beat time, you can learn to play the Buescher Saxophone, Easily! You can teach yourself, at home, in a few evenings. Three simple lessons given on request with each new Saxophone start you. You learn scales in an hour and start playing tunes in a week. Your progress will astonish and delight you and surprise your friends.

Try Before Buying. Easy Terms

Take home with you any Buescher instrument, Trombone, Cornet, Trumpet, Saxophone for six days' trial. Test it. See what you can do with it. If you like it, pay a little each month. Play as you Pay. Satisfaction guaranteed. Send for beautiful free catalog of any instrument and details of trial and payment plans. No obligation. Do this today.

BUESCHER BAND INSTRUMENT CO.
Everything in Band and Orchestra Instruments
2305 Buescher Block Elkhart, Indiana

free BOOK

The Story of the SAXOPHONE

Gives complete history and tells why the Buescher is so easy to learn to play. In it you will find the first lesson chart. You must have this fine book.

Clip the Coupon NOW!

BUESCHER BAND INSTRUMENT CO. 305A
2305 Buescher Block, Elkhart, Indiana.
Gentlemen: Without obligating me in any way please send me your free literature. I am interested in the instrument checked below.
Saxophone☐ Cornet☐ Trumpet☐ Trombone☐ Tuba☐
Mention any other.....
Name.....
Address.....

Simplest Flying Model

(*Continued from page 81*)

is fitted into a notch at the rear of the fuselage and glued and bound into place. The other two sides of the tail frame are made of silk thread. Cut a very slight slit across the under face of the fuselage 5 in. from the tail end. Split one end of the tail spar and fasten the thread in it; then lead the thread into the notch in the fuselage and fasten it to the other end of the spar. Draw the thread tight enough to spring the spar forward slightly; this keeps the tail surface taut.

Cover the underside of the tail with bamboo paper. Spread glue along the spar and thread, lay on the paper and press it down to assure its sticking. It is not necessary to turn the margin of the paper over the thread. Just trim off the margin, leaving only 1/16 in. of it beyond the thread. Trim off the margin along the spar with a razor blade. Give the tail one coat of bamboo varnish.

THE rudder outline is made of 3/64 by 1/16 by 12 in. bamboo. Force one end into a hole drilled into the end grain of the fuselage and the other end into a hole drilled vertically through the fuselage 3/8 in. from the tail end. The brace is 3/64 by 1/16 by 3 1/4 in. bamboo. Force it into place, cover both sides of the rudder with bamboo paper and give each side one coat of bamboo varnish. Trim off the margin with a razor blade.

The main wing is of the single-surface type. The spars are 3/32 by 1/8 by 24 in. white pine. The rear spar is bent at the center until the ends are 1 in. higher than the center; the front spar should be bent until the ends are 1 3/4 in. higher than the center.

White pine is bent in the same manner as bamboo, but should first be soaked with water at the point where the bend is to occur.

There are seven bamboo ribs 1/16 by 1/16 by 4 in. They are bent in a curve, the highest part of which is located one third the rib length from the leading edge. The center rib should be nearly flat, and the others bent up about 5/16 in. The ribs are spaced 3 3/4 in. apart. Put a drop of glue on the spar and bind each rib in place with four wraps of silk thread each way.

The tips are 1/16 by 1/16 by 8 in. bamboo and extend 3 in. beyond the ends of the spars. They are bound to the inner edges of the spars with silk thread and glue.

After the wing is assembled, true it up and allow it to dry thoroughly. Cover the frame on top with bamboo paper and apply two coats of bamboo varnish.

THE wing saddles are made of 1/32 in. diameter piano wire. Start bending at the center of the wire, making two bends straight down 1/8 in. apart. Go down 1/4 in. and bend the wire up at such an angle that it will meet the wing spar 3/8 in. from the center line. Here an offset or notch is made to fit the spar. The wire is then led across 4 in. and another spar offset is made. Bend the other end exactly the same way. Make two of these and snap one onto the front spar and the other onto the rear spar. These saddles must be accurately made, as they govern the wing adjustment.

The propeller is made from a block of soft white pine 1/2 by 1 1/8 by 8 in. Draw the blade outline and cut the block to form a propeller blank. Drill a 1/8-in. hole exactly in the center. Carve the back face of the propeller concave and the front face convex. The contour of the blade's cross section should be such that it resembles a wing curve. Sandpaper the propeller to a smooth finish and balance carefully so it will not vibrate when turning.

The propeller shaft is made of bicycle spoke 2 3/4 in. long. Turn a rubber hook at one end with a pair of pliers. Lead the shaft through the bearing and put on two washers of copper with 1/8-in. holes. Force the propeller onto the shaft and then

(*Continued on page 129*)

Build and Fly a 3-ft. Model of
LINDBERGH'S
"Spirit of St. Louis"

Plans for Model Airplanes 25c per set
New York-Paris Plane, FOKKER North Pole Plane, CURTISS JN4D -2 Biplane, DeHAVILLAND Biplane, NC-4 Naval Seaplane, Blériot, Taube or Nieuport Monoplanes, Cecil Peoli Racer.

This IDEAL New York-Paris Monoplane is a perfect copy, 3-ft. size, of the machine in which Lindbergh crossed the Atlantic Ocean. Any bright boy can build this model: The IDEAL Construction Outfit contains everything needed; all parts, fittings, materials and supplies, including careful instructions, plans and diagrams. The model is wonderful; has many features of the original and is guaranteed to fly. Complete Construction Outfit.....**$7.50**
[West of Denver, Colo., send in Canada, price is $8.00]

Ask your dealer or order direct.

New 64-page Book of Model Airplanes

Teaches the principles of flying; contains plans and directions for building gliders and racers, and full information about scale Models of real planes; also most complete catalog of materials for the model builders. Send postpaid for 5c

IDEAL AEROPLANE & SUPPLY CO., Inc.
163-165 Spring St. New York City

EDWARDS METAL ROOFS
LAST LONGER · LOOK BETTER
SAVE YOU MONEY

Edwards Metal roofing, shingles, Spanish tile, sidings, *ready-made garages and farm buildings,* are rust-proof, fire-proof, lightning-proof. Last three times as long as ordinary kind. Quality in every detail. Styles and types for every purpose. Easy and economical to apply. Lifetime satisfaction.

We are the world's largest manulacturers of sheet metal building materials. We control every operation from the raw metal to the finished product. You can buy from us at manufacturer's prices and save all intermediate profits. Write today for our Free Samples and prices. Ask for Roofing Book No. 198 or for Garage Book.

FREE SAMPLES, Books and Estimates

The EDWARDS MFG. CO.
348-398 Butler St., Cincinnati, O.

ZIP-ZIP SHOOTER
LET'S GO, BOYS:

Hunting, fishing or camping, wherever you go you will need a Zip-Zip Shooter, elastic and lasting with plenty of pep and force, scientifically and practically made. See your dealer. If he can't supply you, order from us Zip-Zip Shooter 35c or three for $1.00, send stamps, coin or money order.

AUTOMATIC RUBBER CO., Dept. B. B. Columbia, S. C.

4 SHIP MODEL PLANS $1

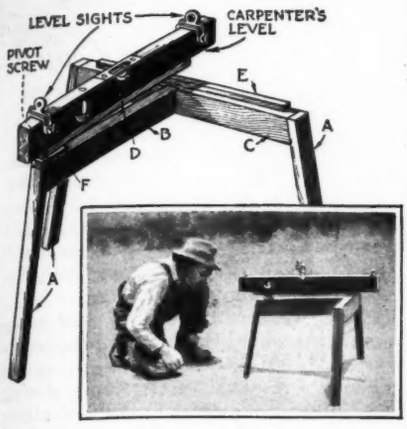
Plans and instructions for Magellan's VICTORIA, Hudson's HALF MOON, Pirate Ship, Clipper ship—all for $1. For a limited time; send NOW. Interesting 32-page catalog, 6c.

SEA ARTS GUILD
730-N WINNEBAGO ST., MILWAUKEE, WIS.

An Authority Tells How To Buy, Install and Operate A Radio For Best Results

The Radio Buyer who follows the instructions contained in the new 20-page radio booklet published by the Popular Science Institute will get 100 percent satisfaction out of his investment and avoid mistakes. Send 25 cents to Popular Science Institute, 246 Fourth Ave., New York City.

Carpenter's Level Used for Sighting Long Lines



How the tripod stand is made and used for running foundation lines and similar work

IN SETTING foundation corners for small buildings and in grading, ditching and the like, I have found useful a simple tripod made as shown. It supports a carpenter's level equipped with sights of the type that can be obtained in the larger hardware stores.

To make the tripod the following parts are required: 3 legs A, 1 by 2 by 24 in.; 1 backbone B, 2 by 4 by 24 in.; 1 crosspiece C, 2 by 4 by 24 in.; 1 level rest D, 1 by 2 by 30 in.; 1 filler piece E, 1 by 1 by 24 in., and 1 filler piece F, 1 by 2 by 2 in.—GEORGE W. ROYER.

IN MAKING small parts for models I have found useful old safety razor blades of the type having a stiff back. These are broken, chipped, ground and filed into various shapes to suit the need of the moment, the back being retained as a handle.—C. BALDWIN WHITE.

Simplest Flying Model

(*Continued from page 128*)

turn a tight loop on the end and force this loop into the wood at the propeller hub.

Give the fuselage skid and propeller two coats of bamboo varnish.

Loop on six strands of 1/8 by 1/32 in. flat para rubber. Lead the rubber from the propeller shaft through the "cans," over the top of the wing, to the rear hook. One may lubricate the propeller shaft bearing with a drop of oil or vaseline.

To fly the model, press the wing saddles onto the fuselage and loop a rubber band over the wing and under the fuselage. The leading edge of the wing will go about 11 in. from the propeller. Glide the model. If it glides heavily to the ground, move the wing forward. If it shoots up sharply and stalls, move the wing to the rear. Adjust the wing until the model makes an easy glide.

WIND the rubber clockwise until there is a row of knots its full length. Start the model above your head in level flight with the wind. The model may be turned to the left or right by forcing a slight bend in the rudder. After the model is correctly adjusted it may be wound its full number of turns, about 400.

This model will make beautiful long flights consistently and go up to a high altitude.

RAZOR PULL *Disappears!*

when beards are softened this Small Bubble Way

Men, it's a shave with a smile!

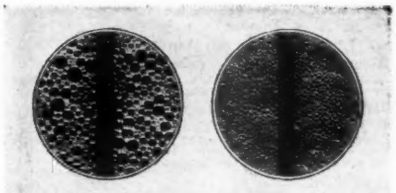
A smoother shave, a quicker shave . . . is yours for the asking now. It's an amazing new type of lather that softens your whiskers in a scientific way

SKIN sensitive? Beard tough? Forget it, men.

Here's a new, quick way to shave that gets whiskers off clean and smooth . . . without razor-pull, sting or smart.

Already millions have adopted small-bubble lather. Thousands buy it daily. From coast to coast the news has spread like wildfire.

And now, to broadcast the good news even further, a unique test is offered. It's a seven-day trial that doesn't cost you a cent. See details in coupon below.



ORDINARY LATHER

Photomicrograph of ordinary lather surrounding single hair. Note how the large bubbles hold air instead of water against the beard.

COLGATE LATHER

Under identical conditions note the closely knit texture of Colgate lather. The small bubbles hold water instead of air against your beard.

Small Bubbles did it

No other shaving cream is like Colgate's. No other can offer you such unique results.

It is, we believe, the ultimate attainment in the science of beard-softening. A shaving cream based on the now proven principle that water, and not soap, is the real softener of your beard.

Thus Colgate lather is designed to absorb more water . . . to scientifically drench your beard with moisture right at the base, where the razor work is done.

It's a "small bubble" lather. For small bubbles hold more water. They carry it closer to the base of your beard.

The minute you lather up with Colgate's two things happen:

1. The soap in the lather breaks up the oil film that covers each hair . . . floats it quickly away.

2. Then billions of tiny, moisture-laden bubbles seep down through your beard . . . crowd around each whisker . . . soak it soft with water.

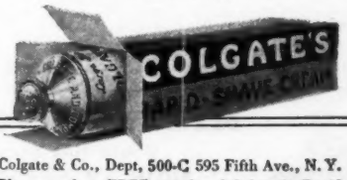
Thus your whiskers come off clean and smooth. No razor-pull. No stinging and smarting.

You've never had a shave like this before. You've never known such comfort.

Please don't take our word for all this. Make us prove what we say.

Compare Colgate's for seven days with the shaving cream in your bathroom now . . . we'll cheerfully stand the expense. Please mail coupon . . . *now!*

FREE OFFER, MEN!



Colgate & Co., Dept, 500-C 595 Fifth Ave., N. Y.
Please send me FREE sample of Colgate's Rapid Shave Cream. Also sample of Colgate's Talc for Men.

Name_____

Address_____

Sent for Only $1.00 down

DIRECT FROM FACTORY

STUDEBAKER

The Insured Watch Save 30 to 50%!

21 Jewels Extra Thin

Think of it! Just $1.00 down brings you the famous 21-Jewel Studebaker Watch direct from factory. Balance in easy monthly payments. Lowest prices ever named for equal quality. By buying direct you save 30% to 50%. Your choice of 80 magnificent, new Art Beauty cases and dials. Latest designs in yellow, green and white gold effects. Exquisite thin models. 12 Size and 16 Size. Send coupon for catalog of Advance Watch Styles and full particulars.

The Studebaker Watch Company is directed by members of the famous Studebaker family—known throughout the world for three-quarters of a century of honest dealing. Studebaker Watches have 21 Jewels, 8 Adjustments—Insured for your lifetime! Insurance Policy FREE! Ladies' Bracelet Watches, Men's Strap Watches, Diamonds and Jewelry also sold at lowest prices and easy monthly payments. Send coupon for details.

Mail Coupon for 6-Color Catalog!

Let us send you a copy of our beautiful new 6-color catalog. It contains complete information on watch making. It tells how you can buy a 21-Jewel Studebaker Insured Watch direct from the maker—save big money and pay for it in easy monthly payments. Mail the coupon.

Over 100,000 satisfied customers own Studebaker Watches—and saved money by buying them direct. We ship anywhere.

SPECIAL OFFER! Watch Chain FREE!

For a limited time we are offering a magnificent Watch Chain Free. To all who write immediately we will include particulars of this astounding offer. Time is limited. Send the coupon NOW!

STUDEBAKER WATCH COMPANY
Watches • Diamonds • Jewelry
Dept. J-906 • South Bend, Indiana
Canadian Address: Windsor, Ontario

Save on Ladies' Bracelet Watches, Strap Watches for Men, and Jewelry. Sold on the easiest kind of payments!

Mail This Coupon

STUDEBAKER WATCH COMPANY
Dept. J-906 South Bend, Indiana
☐ Please send me your free catalog of Advance Watch Styles and details of your $1.00 down offer. ☐ Please send me free catalog of Jewelry and Diamonds.
Name .....
Street or R. F. D. .....
City ..... State .....

FANCY WOODS

We have on stock all kinds of hard and soft fancy woods for Inlaying, Models, and Scroll Work. List No. 43 on request. Set of Fancy Wood samples, $1.00.

Also a 184-page Illustrated Catalogue describing our 800 designs for Scroll Work, 70 cents.

H. L. WILD
510 East 11th Street
Dept. P. S New York City

BURN YOUR NAME ON TOOLS
WITH THE
ARKOGRAF
Protect Your Tools From Theft. Write with electricity any name or design on the hardest and finest tools and instruments, or any metal, like writing on paper with pen or pencil. Complete Outfit $3.50 Prepaid Anywhere. Interesting illustrated circular free. Write today. Agents wanted.

ARKOGRAF PEN CO.
1171-A East Stark St., Portland, Oregon

MILLION DOLLAR MOTORS
Could Not Excel These Great Marvels
NOW AT GREATLY REDUCED PRICES
General Catalog $.25 Refunded First $2.00 Order
Bearing, Belting, Books, Brass, Electrical Supplies, Engines, Fibre, Gears, Pulleys and General Supplies for Handy Men, Mechanics, Model Makers

AMALGAMATED SALES AND SERVICE CORPORATION
327 S. South La Salle St. Chicago, Illinois

Plumbing Hints for Home Owners

Water Heating Coils

By HUGH WILLIAMS

BY FLUSHING out the water-heating coil in the fire pot of your house heating furnace or boiler and by keeping a duplicate coil always on hand so that it can be speedily installed in an emergency, you can forestall trouble with this part of your plumbing system.

There are several reasons why every householder should give careful consideration to this subject. For one thing, no coil will give satisfactory results during both mild and extremely cold weather. Its presence in the fire pot creates a dead spot directly below so that the coal at that spot is not entirely burned. Then too, coils will break, usually, it seems, on Sunday, a holiday or at night, when it is almost impossible to get a plumber.

Coils are made in various shapes and in both iron and brass. The writer recommends one-piece bent pipe coils, which are the cheapest, interfere with the fire the least, and offer a smooth interior passage for the water. Brass pipes and fittings are, of course, to be preferred.

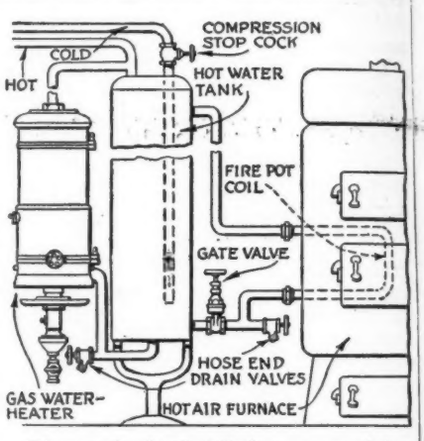


Diagram showing installation recommended by Mr. Williams. The vent on the gas water-heater must be connected to a chimney

It is better to install a small coil that will deliver hot water in the coldest weather only. Use the gas water-heater during the fall and spring or on mild days during the winter. Furthermore, keep the coil away from the center of the fire.

Install a control valve, preferably a wheel-handled compression stop cock, on the cold water supply to the hot water tank. Then, when the coil does break, the water can be turned off at this point.

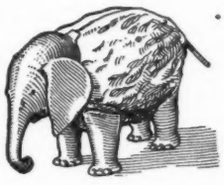
Install a gate valve in the return pipe between the coil and the tank, with a wheel-handled hose-end drain valve in the line on the coil side of the gate valve. Use this frequently to flush out the lime, scale and sediment in the coil by closing the gate valve and opening the drain valve. A good idea is to attach a hose to this drain valve and wet the ashes in the ash pit before removing them. Be sure to close the gate valve to get best results in flushing the (*Continued on page 131*)

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Walnut Shell Made into "Comicull" Elephant

By F. Clarke Hughes

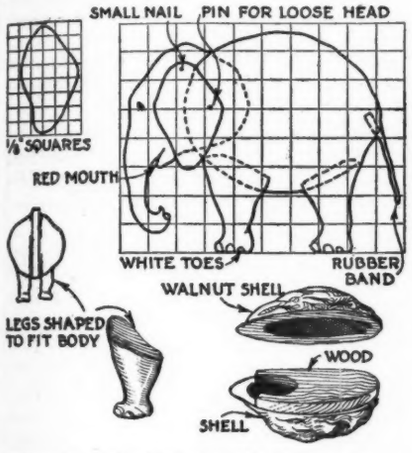
A FEW odd bits of material, a few minutes of time, and a little patience are all that you need to make the little elephant shown as this month's "comicull."



A novelty for use as a dinner favor or toy

First take a large walnut shell and a thin piece of wood that is a little larger than the walnut so that it may be marked and shaped to go between the two halves of the shell. Cut the wood to the shape shown and glue the two sides of the shell to it. Make the head of thin wood and cut out each leg separately to fit against the sides of the shell.

The ears may be made of bits of leather and glued or nailed to the head. Paint as realistically as possible.



How the elephant is made. The larger squares represent ¼ in., the smaller ones, ⅛ in.

Water Heating Coils

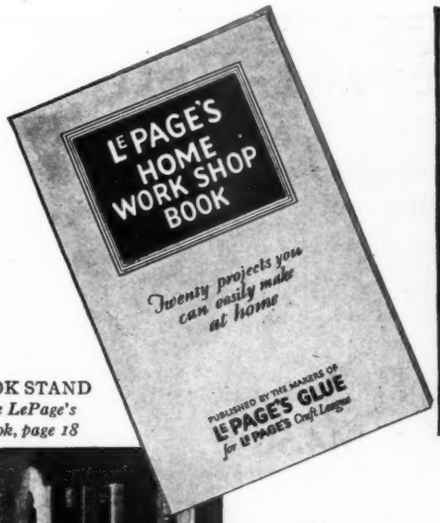
(*Continued from page 130*)

coil, and then be careful to open the gate valve again to insure circulation from the coil to the tank. The flushing will prolong the life of the coil.

Under no circumstances should valves be installed on both coil connections, because the closing of these valves would create a steam chamber that would burst when the fire became intense and probably cause serious damage.

Get a duplicate coil and tie it to the beam right over the heating boiler. Then, when one coil breaks, the plumber can install the duplicate, take the old one back to the shop, and at his convenience make another one, which can be attached to the beam ready for the next emergency.

In making small parts for models I have found useful old safety razor blades of the type having a stiff back. These are broken, chipped, ground and filed into various shapes to suit the need of the moment, the back being retained as a handle.—C. Baldwin White.



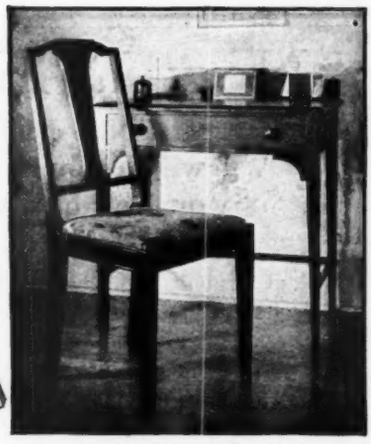
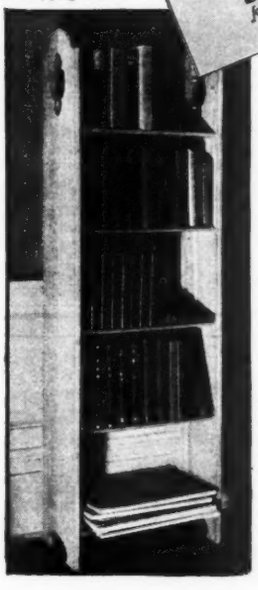


TABLE DESK AND CHAIR
See LePage's Book, pages 15 and 16

BOOK STAND
See LePage's Book, page 18



SMOKING CABINET
See LePage's Book, page 13

Here's LePage's New Home Work Shop Book

—Handed to You for a Dime

A book that cost us $3316.57 to prepare

Contains complete, easy-to-follow directions for making 20 attractive pieces of household furniture

Any man handy with tools can make these handsome, useful articles right at home

EACH piece of furniture was designed for LePage's by an expert—William W. Klenke, Instructor in Woodworking, Central Commercial and Manual Training High School, Newark, N. J. Assurance is given that each article and the directions for making it are perfectly practical.

The directions for each are given in three parts, namely: complete dimension drawing of all the parts, simple printed directions for making given step by step from start to finish, and a photograph of the finished article. Suggestions for suitable woods to use and directions for the best ways to finish each are also given.

The photographs shown on this page show the pleasing results you can obtain for a few evenings' fun (not really work) during the winter. And in addition to the 4 articles shown here, the book includes the following 16 articles: Occasional Table, Spanish Ship Model, Folding Sewing Screen, Fernery Stand, Tilt Top Table, Piano Bench, Costumer, Priscilla Sewing Box, Cedar Chest, Card or Console Table, Turned Bench, Dressing Glass, End Table with Book Trough, Foot Stool, Back Rest and Hanging Book Shelves. Where else could you get complete directions for making all these things for only 10 cents?

Send 10 cents for this NEW LePage's Home Work Shop Book

Over 40,000 copies have already been sold. Just write your name and address on the coupon below, tear it out and mail to us today with 10 cents in coin or stamps, and we will at once send you a copy of LePage's New Home Work Shop Book, postage paid. Address LePage's Craft League, 592 Essex Ave. Gloucester, Mass. Tear out coupon now so you won't forget it.

LE PAGE'S GLUE
HANDIEST TOOL IN YOUR WORKSHOP

LePage's Craft League,
592 Essex Ave., Gloucester, Mass.

Gentlemen: Enclosed please find 10 cents (coin or stamps) in payment for LePage's New Home Work Shop Book. Please send a copy of this book to

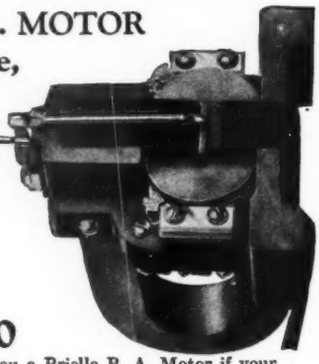
Name .....

Street .....

City ..... *State* .....

New-Different-Better!

The New BRIELLE B. A. MOTOR will revolutionize the tone, quality and volume of your speaker



Look at this unit. Operates on 45 to 800 volts. Requires no output transformer. Handles the output of existing Power Tubes direct through its own coils, without distortion.

Notice the direct magnetic path—producing great sensitivity. Note the broad laminated pole face and large armature surface.

Experts say the New Brielle B. A. Motor is way in advance of ordinary design—sturdy, simple, yet unusually efficient.

$14.50

will bring you a Brielle B. A. Motor if your dealer cannot supply you. This unit is all ready to be installed in your own cone speaker. Mail check or money order. We will pay the postage.

For $5.25 additional you can build your own Brielle Cone Speaker, with special Vibratex Cone. Send for the Brielle Kit containing all the materials and complete directions for assembly. The Brielle Kit is specially designed for the new Brielle B. A. Motor.

G. R. Penn Manufacturing Co., 34 West 3rd St., New York, N.Y.

Thinking of Building?

THEN you will want this book of photographs and floor plans of over 75 beautiful practical homes. Artistic in design, sturdy in construction and built of high grade materials, these homes can be constructed at a cost far below the average—when built the Bennett way.

Real Savings for You

Modern methods save you money. All framing materials are cut to fit by labor saving machines in our great mills. Your house is erected piece by piece as any other house is built—minus the bothersome planning and unnecessary labor. *No architects' fees* as complete plans are furnished FREE with each house. *No waste materials*—yet plenty for every purpose. *No extras*—as our prices are guaranteed. What's more, you buy direct from us at *WHOLESALE PRICES.*

Send for the Book of Bennett "Better Built" Homes and see in advance just what your home will look like. Take no chance—know the exact cost before you start.

Bennett Homes
Better Built

Mail this coupon today!

Bennett Homes, 1038 Main St.,
N. Tonawanda, N. Y.
Please send me the 84 page Bennett Book. Free only in Ohio, N. Y., N. J., Pa., and New England. Elsewhere $1.00.
Name .....
No. and St. .....
Town and State .....
Am interested in house...garage...summer cottage...

fix it yourself all you need is heat

If a household utensil goes wrong—Solder it!

It's a regular hobby with thousands of people—to fix things themselves. And now, with Kester Metal Mender men, women and boys actually solder!

You too, can use Kester Metal Mender expertly right in your own home. Kester requires only heat, is easy to use, and it's a genuine solder, too! It carries a scientific flux inside itself. Like the lead in a pencil, this flux does the work.

If a part of a car or tractor goes wrong—Solder it!

Think of how many useful things you could put back into service with just a touch of Kester, here and there.

If you have electrical wiring to do—Solder it!

Buy a can today from your hardware dealer, general store, auto supply shop or druggist. If you want to be convinced without expense—write for Free Sample.

KESTER METAL MENDER
The Household Solder
CHICAGO SOLDER COMPANY
4203-09 Wrightwood Ave., Chicago, U.S.A.
Established 1899

A Guide in Choosing a Radio Set

(*Continued from page 70*)

as well be operated on direct current from a storage battery, although they wouldn't be desirable for such use because of the heavy current required at comparatively low voltage.

Then there are the heater type tubes, such as the 227 type, where the filament is used to heat a cathode or small hollow cylinder, and the latter supplies the stream of electrons to operate the tube. These tubes operate on raw alternating current stepped down to two and one half volts. They, too, could be operated with just as good results on direct current from a storage battery.

Another type of full electric set uses ordinary 201A tubes or 199 type tubes. The built-in B-eliminator in such sets is made large enough so that in addition to the B and C requirements of the receiver, it will supply the necessary direct current for the A or filament circuit. The filaments of the tubes are connected in series.

The third system is to take a standard type of battery set and build into it an A-eliminator as well as a B-eliminator. Sets of this type are just as fully "electric" as any others, provided they require no attention beyond the occasional replacing of a tube. However, this method calls for more apparatus and the additional advantage may not compensate for the extra expense.

Now as to the relative advantages of these various types of electric sets, it all depends on whether or not you buy high grade apparatus. Theoretically each system is capable of equally good results and the only question is, therefore, whether these results are obtained in the particular set you are thinking of buying. And the Popular Science Institute of Standards can help you decide that point.

Radio apparatus, including electric sets, eliminators, A C tubes and all the most modern items are tested and their money value determined. Approval by the Institute means that the apparatus approved is worth the money. If, for instance, a particular electric set costing $150 appears on the approved list it means that the receiver is carefully constructed according to approved methods of reliable parts and will give good service. Naturally, it will not be as good as a $300 outfit. If it were, then the $300 outfit would not be worth what it cost and could not appear on the list.

A Wireless Electric Light

AN EXTRAORDINARY new type of electric bulb without wires, developed by Dr. Phillips Thomas, research engineer of the Westinghouse Electric and Manufacturing Company, glows when held within range of a powerful electromagnet, and continues to glow for ten minutes after the power is shut off! Though you could turn it off, undress, and jump into bed by its light, it has no such immediate utilitarian purpose. It was developed by Dr. Thomas in the course of experiments he is conducting on the transmission of power by radio.

What We Owe to Newton

(Continued from page 35)

A trifling difference of less than three feet in the figures would not bother some theorists, but to Newton it was a great discrepancy, and caused him to abandon the research for the time.

Four years later Newton went back to the problem and found that he was right the first time and would be forever—if Einstein permits—right. Gravitation was established and the universe was safe. The cause of the early discrepancy in figures was an imperfect measure of the earth which gave a degree of latitude as being sixty miles. The corrected distance for a degree of latitude was 69.1 miles. The new calculation on the pull of earth upon her lunar friend worked out very closely and the law of the inverse square became a permanent part of human knowledge. This law rules in light as in the physics of gravity. It is in fact a self-evident truth.

THE best illustration of the inverse square is in light. One square foot of light at twice the distance from the source, or two feet, spreads to cover four square feet of surface. If the distance is again squared to four feet, the original square foot of light spreads to cover sixteen square feet. The original amount of light remains the same, and spreading, it reduces or thins it in the proportions given. In the last case a square foot has one sixteenth the intensity of the original amount of light.

Gravitation works on the same obvious principle, though invisibly. It is a magnetic force that spreads from the center of a sphere equally in all directions, increasing or diminishing according to the square of the distance from the central source. It is mutual between spheres. All matter partakes of it. Size or mass is a ruling factor.

Everything was grist to Newton's mathematical mill. While plumbing the depths of celestial space he analyzed the laws of chance that govern card playing for the benefit of his friend Pepys, man-about-town and author of the well-known "Diary."

In Newton's time scientists had queer ideas on light and especially as to the origin of color. For example, red was supposed to be a condensed form of light, while blue was composed of black and white particles, as illustrated by the ocean mixture of black water and white salt. Instead of guessing in this way, Newton made a hole in a window shutter, let a ray of sunlight pass through the hole and then through a glass prism. Thus the white light was separated into the color elements of the spectrum from red to violet. The young experimenter measured all angles and distances, shifted his prism in every way, added more prisms and combed out by itself each band of spectrum color.

HE THEN announced to the world what is now taught to every school child: that white light is composed of rays of different wave lengths and that these rays, if separated, affect the eye as color—red for the short lengths and violet for the long lengths. Objects that we see as colored only seem so because they reflect a particular kind of ray and absorb the rest of the light.

Having found that the rays of white light do not focus together through a lens, Newton decided that the only efficient telescope must be on the reflecting or mirror principle. He built one on this principle that was a mere six inches in length, and yet it could magnify forty times, or as much as any refractor telescope a dozen times as long. With his tiny instrument the young man who was soon to become the master surveyor of the universe "saw . . . Jupiter distinctly round, with his four satellites, and also the horns or 'moonlike phase of Venus.'"

(Continued on page 134)

COLUMBIA UNIVERSITY

Offers Courses for Home Study in the following Subjects

Accounting
Algebra
American Government
American History
American Literature
Applied Grammar
Astronomy
Banking
Biblical Literature
Biology
Botany
Boy Scouting
Business Administration
Business English
Business Law
Business Organization
Composition
Dramatic
English
Various Languages
Lyric Poetry
Chemistry
Child Psychology
Contemporary Novel
Drafting
Drama
Drawing and Painting
Economics
Economic Geography
English
English Literature
Essay Writing
European History
Fire Insurance
French
Geometry
German
Government
Grammar
Greek
Harmony
History
Italian
Juvenile Story Writing
Latin
Literature
Magazine Article Writing
Marketing
Mathematics
Personnel Administration
Philosophy
Photoplay Composition
Physics
Psychology
Public Speaking
Religion
Secretarial Studies
Short Story Writing
Sociology
Spanish, etc., etc.

THESE courses have been prepared by our instructors to meet the special requirements of study at home by individuals or groups. While all basic material essential to the full understanding of each subject is fully covered, sufficient elasticity is allowed to permit adaptation to the individual needs of each student. Everyone who enrolls for a Columbia course is personally instructed by a member of the University teaching staff.

The University will send on request full information about these home study courses. A coupon is printed below for your convenience. If you care to write a letter briefly outlining your educational interests our instructors may be able to offer helpful suggestions. Mention subjects which are of interest to you, even if they are not listed above because additions to the courses offered are made from time to time.

HIGH SCHOOL AND COLLEGE PREPARATORY COURSES

COLUMBIA University Home Study Department has prepared courses covering the equivalent of four years of High School study. This complete High School or College Preparatory training is available to those who cannot conveniently undertake class room work. We shall be glad to send you our special bulletin.

PS-3-28

COLUMBIA UNIVERSITY,
University Extension—Home Study Department, New York, N. Y.

Please send me full information about Columbia University Home Study Courses. I am interested in the following subject:

.....

Name.....

Street and Number.....

City.....State.....Occupation.....

1289

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

$4.00 BUYS THIS JIG SAW

[furnished with 3 steel blades]

FOUR DOLLARS is not the first installment, but the FULL PRICE for this Jig Saw with three tempered steel blades. It will cut anything from cigar box to ⅜" wood, bakelite, celeron (for radio panels), etc.

A practical every day tool for the set builder, amateur mechanic, and woodworker, AT A PRICE EVERYONE CAN AFFORD. Blade is protected by guard. Manual of woodworking and wood stamped with design for cutting, furnished free. Height 9", weight 3½ lbs, $4.00 plus postage.

KNAPP ELECTRIC CORP.
Dept. 88 Port Chester, N.Y.
Manufacturers of
"AMERICAN INDUSTRY IN MINIATURE"
REG. IN U.S. PAT. OFF.
Drill Press - $4.50 Lathe - $6.00
Work Shop, complete with motor - - $27.50
Catalogue in full color for 10c in stamps
Price Denver West and Canada slightly higher
FOR SALE BY F. T. EATON CO.

When white water roars a challenge

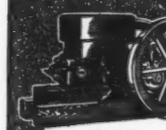
WHEN the rapids swirl and leap about you; when the swift current carries you on at express train speed, then you'll be most grateful for the perfect balance of your "Old Town Canoe."

"Old Towns" are patterned after actual Indian models. Famous for their steadiness and durability. Light in weight too. Priced as low as $67. From dealer or factory.

New catalog gives complete information about all models, including sailing canoes, square-stern canoes, dinghies, etc. Also racing step-planes, baby buzz hydroplanes, etc. Write for free copy today. OLD TOWN CANOE CO., 1893 Main Street, Old Town, Maine.

"Old Town Canoes"

ENGINES



Send for my new chart ....*"How to Select Your Engine."* Avoid mistakes and disappointments by getting proper SIZE and H-P. for your work. My 68 years engine building experience is yours for the asking.

WITTE SUPER ENGINES

50 new features now place the WITTE Engine head and shoulders above all others. Alloy steel construction.... All fuel carburetor uses cheap fuels. All parts interchangeable. Removable die-cast bearings. Hot spot cylinder head. Center fire. WICO Magneto.

Send name at once. ED. H. WITTE, Pres.

WITTE ENGINE WORKS
2223 Oakland Ave., Kansas City, Mo.
2223 Liberty Ave., Pittsburgh, Pa.

KEROSENE GASOLINE
GAS OIL DISTILLATE
OR GAS

Airplane, 50c
12-Inch Cross-Atlantic Model, "Lindy" type.

Takes off by own power. Travels 40 feet. Very fascinating and educational. Thrilling fun! Easy construction set, complete materials, postpaid U. S. 50c (no stamps). Satisfaction guaranteed or money refunded.

Model Aircraft Co., Box 331, Chillicothe, Ohio

TWO FREE BOOKS

Breed squabs and make money. Sold by millions at higher prices than chickens. Write at once for two free books telling how to do it. One is 40 pages printed in colors, other 32 pages. Ask for Books 3 and 4. You will be surprised. **Plymouth Rock Squab Company, 616 H Street, Melrose Highlands, Massachusetts.** Established 27 years. Reference, any bank or trust company.

All Separate Machines in Boice's Home Work-Shop!

Here's Boice's new Work-Shop! Note each machine is large size and complete in itself. That means rigidity, greater accuracy. Always ready for work, no assembling. Quiet motor, smooth power. Machines operate separately or together as preferred.

Compare size, capacity and quality with any other work-shop. Circular Saw cuts stock to 2½ inches. Table 15" x 17" tilts 45°. Jig Saw uses ⅛" to ¾" blades. Stroke 1½". Lathe has 3 speeds; 8" swing; 19" C. to C. For wood or light metal turning. **Books of Designs** for making toys, furniture, etc., included with outfit. Send 10c for Boice Catalog and other literature.

W. B. & J. E. Boice,
Dept. P. S. 3-D
Toledo, Ohio

What We Owe to Newton

(*Continued from page 133*)

As usual, scientific rivals tried to shake Newton loose from his optical discoveries. Had he not made a mistake with his prisms and angles? Newton was the bulldog breed. He had proved, he knew, and he never let go of any truth once in his grasp. The rivals growled and in due time backed away.

Like other geniuses, Newton had his blind spots. The first was alchemy and the second was a sort of fantastic theology. He wrote to a friend about to travel through Europe, asking him to "look into the very profitable science of turning base metals into gold."

To understand such apparently childish credulity it is well to recall that alchemy and chemistry were twins in Newton's day; knowledge was in a pioneer state. Furthermore, his fondness for alchemy did not alter by a hair's breadth the rigor of his mathematical research in pure and applied science. Again, the alchemist has almost regained respectability today—transmutation of elements is now accepted theory—sober scientists declare they have turned mercury into gold.

WE MAY compare Newton, the alchemist, with Sir Oliver Lodge, the modern spiritist. Each is sound in science; each may be half right in his hobby.

Honors came to Newton steadily, from a professorship of mathematics at twenty-eight, to his becoming member of Parliament, a knight at the hands of the queen, president of the Royal Society and master of the royal mint. He took the latter job very seriously, devising improvements in coinage and ways of preventing counterfeiting. The custodian of the currency was annoyed when the world kept pestering him with questions on gravitation. He seemed to think that, after all, the royal mint was pretty important and gravitation was a topic to consider after business hours.

Newton never married. It is said that he kept a tender place in his heart for the girl playmate, Miss Storey, for whom he built doll furniture, and he provided for her financially in her latter years although she was twice married.

Toward the end of his long life of eighty-five years, Sir Isaac Newton said of himself with revealing and appealing modesty:

"If I saw farther, 'twas because I stood on giant shoulders."

HE MADE another statement yet greater that has deservedly become a classic, a thought of sublime humility and wisdom that man will never surpass and that may outvalue all his concrete achievements:

"I do not know what I may appear to the world; but to myself I seem to have been only like a boy playing on the seashore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, while the great ocean of truth lay all undiscovered before me."

Trees Gage Wind Velocity

YOU can judge how fast the wind is blowing by trees' leaves and branches, says a French observer, who gives this table:

No appreciable wind, leaves still, up to two miles an hour. Light breeze barely noticeable, leaves feebly agitated, five miles. Moderate breeze, branches stirring slightly, ten miles. Branches bend a little, fifteen miles. Branches rocking and swinging, poplars bending, twenty miles.

Leaves torn from the trees, twenty-five miles. Tempest, light branches broken, thirty-five miles. Violent tempest, strong branches broken, fifty-five miles. Hurricane or tornado, damaging house roofs, in the neighborhood of eighty miles an hour.

Ⓢ This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Both Dad and Sonny Can Use This Buddy "L" Chest of Tools

35 Tools in This Big Chest

Vise, 16-inch saw, claw hammer, coping saw with blade, hand drill, 3 twist drills, 8-inch brace, 3 wood bits, spoke shave, 6-inch try-square, 3-inch screw driver, block plane, nail set, pliers, pencil compass, 2 tang butt chisels, 2-foot fold rule, marking gauge, carpenter's pencil, mounted oil stone, 6-inch file, wood miter box, apron, stamped wrench, 3 pkgs. nails, tang firm gauge, lock, wood cut-out set.

Four assortments from which to choose. Above is No. 4. No. 3 has 26 tools; No. 2, 23 tools; No. 1, 20 tools. All chests same size.

Big, man-size tools packed in a rugged, iron-bound chest—not toys but real tools—big enough for Dad's repairing around the house—and just the right size so Sonny can build his own playthings for himself and friends.

And Buddy "L" FREE Blue Print Service shows him toys to make and how to build them—interesting, instructive, amazing, profitable.

You've always wanted a chest of best quality tools around the house. Here it is. Look at this picture. See the big, sturdy tools that never will wear out. Made by such manufacturers as Disston, Stanley, Greenlee Bros., Vaughan & Bushnell, Millers Falls and others just as famous—the kind of tools best carpenters use.

You just can't know what a wonderful chest of tools this is until you really use it. Write us. Send us your hardware dealer's name. We will give you prices, pictures and tell you about our FREE blue print service for building fun-making toys. Write TODAY!

MOLINE PRESSED STEEL CO., Dept. PS
EAST MOLINE, ILL.
"Builders of the World-Famous Buddy 'L' All-Steel Playthings"
Sales Offices: 200 Fifth Avenue, New York 788 Mission St., San Francisco

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Special prices now! - save more than ever

You can buy this home NOW for as low as $38.70 Per Month

Wait no longer to build your new home. This year, reduced prices and extra liberal terms make it easy for anyone to own a home who wants one. If you are able to pay rent, you are able to buy a Sterling Home on our easy-payment plan. Our customers claim average savings of 47% by buying from us instead of from their local builders.

We Advance You Cash to Help You Build

We ship you any home you select, ready to erect, and ADVANCE YOU CASH to help you build. You pay us in small amounts monthly, just as you pay your rent—and your rent money is saved instead of spent. Any Sterling home, from a cozy 5-room cottage to a sumptuous two-story dwelling, can be purchased in this easy way. And, at the same time, you get a home at a much lower price than your local builders would charge.

Other Homes at $15 to $60 Per Month

You can buy a Sterling Home for as low as $15 per month or as high as $60 per month. A great variety of styles to choose from—at $474 to $2888. Prices include everything complete, FREIGHT PAID to your railroad station. Not a penny's expense for extras—not even for nails, paint or putty. Send 25c in coin today for beautiful Color Book of Sterling Home Plans and you can be living in a home of your own before another month is over.

COLOR BOOK OF Sterling Home Plans 25¢

International Mill & Timber Co.
8310 S. Wenona Ave., Bay City, Mich.

If you want financial independence read the story "How a Big Load Was Lifted from Harry Wilson's Mind" on page four of this issue.

A POST CARD BRINGS IT TO YOU

MY ONLY SALESMAN $2.75 for 50

I DON'T want you to order a quantity of cigars until you try my complete line consisting of 7 brands put up as illustrated above. If after a fair trial you feel that you did not receive at least "DOUBLE VALUE" I'll return your money in full.

HOW I do it. I import my own tobacco and maintain the largest cigar factory selling for cash, eliminating book-keeping, bad debts, etc., and sell my entire output direct to the consumer.

All transportation charges prepaid.

I CANNOT afford to sell more than one trial Sample case to a person at this price. Mail Check or Pay the Postman.

JAMES B. HALL JR
DEPT. P 176 E. 127TH ST. N.Y.

The Old Reliable Credit Jewelers

LOFTIS BROS. & CO. Dept. L371 108 N. State St. Chicago, Ill.

DIAMONDS CASH OR CREDIT

Genuine Diamonds Guaranteed

Bigger Diamond Ring Values!

Newer styles, finer quality, bigger values. We import our Diamonds from Europe—that's why we can sell to you for less. Our rings are solid 18-k white gold, magnificently engraved, and set with gorgeous blue white Diamonds of exceptional beauty. Order now!

No. 871 $200 $5 a wk.
No. 872 $125 $3.25 a wk.
No. 873 $50 $1.25 a wk.
No. 874 $100 $2.50 a wk.
No. 852 $37.50 $1.00 a wk.

No. 857 Ladies' Wrist Watch Solid 14-k white gold case, 15 jewels. $27.50. $2.75 down $2.75 a month

Satisfaction guaranteed, or money back. Goods sent for your free examination on request. Credit terms: Pay one-tenth down; balance weekly, semi-monthly, or monthly at your convenience. All goods delivered on first payment.

Send for Free Catalog

Big 132-page book, illustrating our Diamonds, Watches, Jewelry Silverware, and gift articles for all occasions, sent absolutely free. Write today.

No. 857 $100 $2.50 a wk.
No. 847 $150 $3.75 a wk.

Men's Diamond Rings

Two exceptional values in men's Diamond rings. Each ring is solid 18-k white gold, hand carved and engraved, set with a magnificent blue white Diamond. Order yours today!

"To Be Successful, Look Successful"—own and wear a genuine Diamond!

Wedding Rings

No. 824—The "Elite" $7.50 solid 18-k white gold Set with 3 Diamonds, $22.50; 5 Diamonds, $32.50; 7 Diamonds, $42.50; 9 Diamonds, $52.50; 12 Diamonds, $67.50. All platinum, $25. With 5 Diamonds, $60; 5 Diamonds, $70; 7 Diamonds, $80; 9 Diamonds, $100; circled by Diamonds, $200.

Special Bargain!

Men's strap watch, nickel, cushion shape, 6-jewel, high-grade movement, fine leather strap $8.50

17-Jewel Elgin No. 24 This Model

White gold filled, 20-year quality case; 12 size; silver dial; assorted patterns. $23.50. $2.35 down and $2.35 a month.

Railroad Watches—Guaranteed to Pass Inspection

HAMILTON NO. 992. 21 Jewels. Adjusted to 5 Positions. Gold filled 25-Year Quality Case $55

ELGIN'S LATEST RAYMOND. 21 Jewels, 8 Adjustments. Runs 40 hours one winding. Gold filled 20-Year Quality Case . . . $55

ILLINOIS "BUNN SPECIAL." 21 Jewels. Adjusted to 6 Positions. Gold filled 25-Year Quality Case. 60 hours one winding . . . $50

CREDIT AT CASH PRICES

Where Did You Catch Cold?

(*Continued from page 28*)

to intense cold to see just what effects it would have. In the laboratory their necks were exposed to a gust of icy air—one of those drafts we have been taught to fear. This artificial north wind was allowed to blow for some time, after which its victims were examined.

The examination revealed, for one thing, a set of sore throats. Furthermore, there was an apparent increase in the number of germs inhabiting the throats.

The experimenters concluded that one factor in the beneficial effects of cold bathing and outdoor living may be the training of the blood vessels to react to chilling by increasing the blood supply and so destroying germs—an example of the tendency of nature to cure its own ills.

When we hear of a cold wave, we think of snow and blizzards, yet the term literally describes the way colds affect the country. They do not confine themselves to one spot or even to one region. They cover the country.

SEVERAL investigations have been made to determine the extent of these epidemics and the time of their occurrence. One survey, recently made by the Federal Government, showed that, regardless of great differences in temperature, colds increased simultaneously all over the country, and decreased simultaneously.

The time of greatest prevalence was found to be January and February. The second worst time of the year was October, with the coming of cold weather; the third, early in spring. Some evidence tends to show that neither the incidence nor the severity of the disease has direct relation to climate, but that both are due rather to radical changes in dress and to other changing conditions in our mode of living which go with variations in the weather.

The Metropolitan Life Insurance Company has figured the effects of cold down almost to a degree of temperature. Using 6700 employees at its headquarters in New York as a basis of investigation, the company found that a drop of ten degrees in the weekly mean temperature meant an increase of eighteen colds in the group. Snow, rain, and humidity, however, apparently had only slight influence.

There are many kinds of treatments for colds. They range from common baking soda to inoculation, and from red flannel to chlorine, the deadly gas used in the World War.

Most doctors advise taking a laxative and sweating the cold out of the system by keeping warm and judiciously using hot drinks.

The inoculation treatment has been approved and disapproved. By means of two vaccines, one prepared from the bacteria in the throat and the other from animals, this treatment is intended to make the patient immune. Remarkable results, however, have been noted in some instances. In other cases, the treatment has had no perceptible effect.

Chlorine gas as a remedy is in pretty much the same status.

UNCERTAINTY regarding the true cause of colds has stimulated scientific research to a point where important discoveries are expected soon. Those engaged in the investigation include the Government, the Chemical Foundation, and the American Drug Manufacturers' Association. The American Telephone and Telegraph Company has undertaken an extensive survey of the disease among its employees. At numerous medical colleges experimental work has been long going on.

These activities indicate the tenacity with which science is clinging to the trail of one of man's worst enemies—an enemy that is invisible, and one whose identity is as yet but dimly discerned.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Your Neighbors Will Pay You $75.00 a week for Your Spare Time

You can easily sell them your spare hours for $3 each by serving as "radio doctor", building them sets, selling them supplies at less than retail. A membership in the Association shows you how to cash in on Radio now and trains you for the $3,000 to $10,000 openings awaiting qualified men. The Association starts you in business if you wish. Investigate all it has done for others, all it can do for you. A MEMBERSHIP NEED NOT COST YOU A CENT.

Earned $500 in Spare Hours

Our members are making big money with Radio. Werner Eichler, N. Y., earns $50 a week—Lyle Follick, Mich. has earned $500—F. J. Buckley, Mo.—makes as much as he receives from employer—**all in spare time.** Our members are starting radio stores, getting better positions, increasing their salaries, earning money spare time.

ACT NOW—for No-Cost Membership

Send post card for details of Special Membership Plan that need not—should not—cost you a cent, and our book, "Your Opportunity in the Radio Industry." It will show you how you can cash in on Radio now—and later.

Radio Association of America
4513 Ravenswood Ave. Dept. PSM-3 Chicago, Ill.

Big Opportunity in Electric Refrigeration

"Yes, we need men who know refrigeration."

".... let us have names of trained men." Letters like these come in constantly. Men who are refrigeration experts can choose from any number of high-salaried positions. Demand far exceeds supply.

Easy Home Study Equips You

Ambitious men, regardless of previous experience, can learn Electric Refrigeration from the ground up in a short time. Our Home Study course makes the subject so clear, anyone can understand it. Takes only spare time. Equips you for position in production, servicing or sales end of business.

Write for FREE Booklet

This is your big opportunity *in a rapidly growing industry.* Don't pass it up. Send your name and address for our Free Illustrated booklet—today.

UTILITIES ENGINEERING INSTITUTE
Dept. 23, 3120 N. Clark St., Chicago

The Vest Pocket Lawyer

A complete law course—clearly analyzed in understandable English. It is a daily guide—a manual of reference for the business man—the law student—the justice of the peace—the notary public—the farmer—the clergyman—the merchant—the banker—the doctor.

360 pp. Price $1.50, postpaid

POPULAR SCIENCE MONTHLY
250 Fourth Avenue, New York City

The Real Estate Educator

A most comprehensive yet concise arrangement of useful facts about buying, selling, leasing and sub-letting of Real Estate, contracting, for erection or repairs, mortgaging, transferring, insuring, etc.

New revised edition.

288 pp. Price $2.00, postpaid.

POPULAR SCIENCE MONTHLY

A Carpenter's Method for Spacing Work Quickly

ALMOST daily in my carpentry work I use a method for dividing large spaces into equal parts that is simple, speedy and foolproof. It is so rapid that I can say what the divisions will measure as quickly as I could measure the length that is to be divided up. This often surprises those who are looking on.

As an example, suppose a partition is to be put up across the end of a room to make a closet and is to be divided into three parts by studs (uprights), as shown below. We do not know just what the length of the partition will be, because we have not yet measured the width of

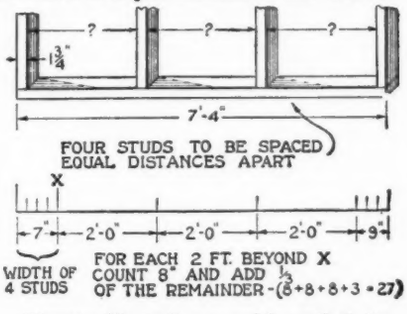


Diagram illustrating a quick method for dividing walls into equal spaces, as for panels

the room, but we do know that four studs will be necessary—always one more than the spaces (except in circular work).

First, we measure on the floor where the partition is to be placed a distance from the wall equal to the combined width of four studs, in this case four times 1¾ in., or 7 in. Here a mark (X) is made. Next we lay our 2-ft. rule down, starting at this point, and say to ourselves not 24 in. but 8 in., or one third of 24, as we are to have three spaces. We lay the rule down again, measuring 2 ft. more but adding mentally 8 in. We do this again and add 8 in. more. In other words, we say 24 in. although our rule has actually covered 6 ft.

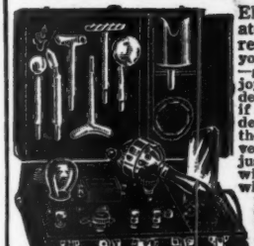
We find a space of 9 in. left over. This we divide by three, and adding 3 in. to 24 get 27 as the distance at which to set the studs apart in order to divide the space into three equal parts. A study of the diagram will make this clear.

If four spaces had been wanted we should have used the same method but added 6 in. each time we set down the 2-ft. rule. For six spaces, we should have counted 4 in. for each move. For five spaces, it would have been necessary to take 20 in. on the rule each time instead of 24, and to count one fifth of that, or 4 in.—H. L. DERBY.

WEAK compression springs can be made longer and often restored to usefulness by holding them on an anvil or some other solid surface and striking between the turns with a cross-peen hammer. The blows should be quick and rather hard. Pass along the spring to keep the tension even and turn it slowly as you work. If the spring is bowed, the same process may be applied to the concave side to straighten it. Gas engine valve springs can be put into excellent condition in this way.—SHERWOOD J. GEE.

With
Violet Ray
Vibration
Ozone
Medical Electricity
The Four Greatest Curative Powers Generated by This

Great New Invention!



Elco Health Generators at last are ready for you! If you want more health—greater power to enjoy the pleasures and delights about you, or if more beauty is your desire—**write!** Ask for the book on these inventions which has just been prepared. It will be sent to you without cost. It tells you how Elco Health Generators aid you in leaving the lethargy and hopelessness of bad health and weakness behind forever. Re-vitalize yourself. Bring back energy. Be wholly alive. Write today!

Here's What Elco Users Say—

"Wouldn't take $1000 for my Elco." "Has done me more good in 2 weeks than doctors did in 3 years." "Cured my Rheumatism." "My Eczema is gone." "Cured my stomach trouble." "Cured my weakness." "Now I sleep soundly all night." "Thanks to Elco my strength and vigor are back." "No more pain." "Colds never bother me now." "Chronic Constipation banished."

Elco Electric Health Generators

These great new inventions generate Violet Ray, Vibration, Electricity and Ozone—combined or separate. They operate on the electric light in your home or on their own motive power at less than 50 cents per year. Elco Health Generators are positively the only instruments which can give you in one outfit Electricity, Violet Ray—Vibration and Ozone—the four greatest curative agents. Send the coupon below. Get the Free Book NOW!

Free Trial

Mail Coupon for Free Book

Do not put this paper down without sending the coupon. Don't go on as you are with pains and with almost no life and energy. You owe it to yourself to be a better man or woman. You were put here to enjoy life—not just to drag through it. So do not rest another day until you have put your name on the coupon here. That will bring the whole story of these great new inventions. Do it today—now.

Lindstrom & Company
30 West Lake St., Dept. 57-23 Chicago

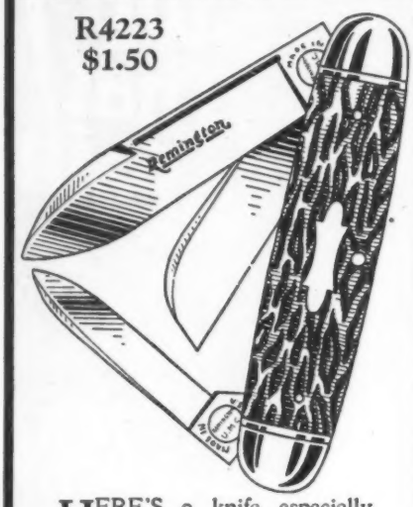
Please send me your free book, "Health—Power—Beauty" and full information of your 10-day Free Trial Offer.

Name .....

Address .....

KNIVES THAT BITE

R4223
$1.50



HERE'S a knife especially designed and built for carpenters and skilled mechanics, professional or amateur. It belongs in every tool kit.

Remington steel is hardened and tempered by a special process, to produce blades with keen, uniform, and lasting cutting edges. Every blade is hand-honed at the factory. When you buy your Remington every blade will bite, and you can keep a biting edge on Remington blades.

R4223 has a heavy spear blade for general use; a sheepsfoot blade for scribing or coping, and a pen blade for delicate work.

Ask to see this knife at your dealer's. Get your hand around the fine stag handle and test the "feel" of it. Notice the fine finish, brass linings, and german silver mountings. You'll want to own one at once. And if your dealer shouldn't have R4223 in stock, send us his name with $1.50 and we will forward the knife to you promptly.

Remington Arms Company, Inc.
Established 1816
25 BROADWAY NEW YORK CITY

Remington

Arms Ammunition Cutlery
Cash Registers Service Machines

C 1928 R. A. Co.

BIG RADIO CATALOG
From the "Big, Friendly Radio House"
NEW 1928 Book offers finest, newest, well-known sets; parts, eliminators, accessories at lowest prices. DEALERS—WRITE for this CATALOG!

Western Radio Mfg. Co.
130 West Lake St., Dept. 22—Chicago, Ill.

When You Buy a Car—

(Continued from page 74)

hand," Gus went on, "the car you're fixing to buy, Ben, is not so good. It isn't much as a hill climber. It's sluggish on the pick-up. It needs overhauling perhaps a little more often than other cars in the same price class. And it needs quite a lot of servicing. Judged strictly on merits as a car, I'd say it was inferior to a number of others I could name."

"Humph!" muttered Ben. "Then I suppose you'll say I ought to follow Hank's advice, eh?"

"Not at all," said Gus. "The quality of a car—any car—is only a part of the story—and sometimes a mighty small part at that.

"As a matter of fact you fellows could have saved yourselves the trip down here. You're both right! Each of you has picked out the car that I would have recommended."

"I don't see how that can be," argued Hank. "You've practically told Ben he's picked a lemon and yet you tell him to buy it. What's the big idea?"

"Well," said Gus, "the point is, I know you two birds. You're a bug on machinery, Hank. You'd take care of a car so well there wouldn't be a chance for any real trouble, and if you do have a breakdown you'll fix it yourself. Chances are after you've once bought your car you'll never go near the dealer again.

"NOW, Ben, you're a lawyer. You don't give a whang-doodle about anything mechanical. You don't know what goes on under the hood of a car and you probably don't care. All you want is a good-looking bus that will stay on the job and get you from place to place without worry."

"But why shouldn't I take Hank's advice?" questioned Ben.

"Two good reasons, Ben," Gus replied. "The dealer who handles the car Hank favors is, as I happen to know, a slick article. He'd stick you for a wad of money every time you poked your nose in his door looking for a little service. That doesn't make the slightest difference to Hank, because he'll never have occasion to go near him. The second reason is that the dealer who handles the car you've picked out would sooner go out of business than take advantage of anybody. Maybe his car isn't quite so good, but he'll keep it on the job for you and that's what counts!

"When you're buying a car," Gus summed up, "don't let a high trade-in offer stampede you into buying a car you really don't want. Pick your car solely on the basis of mechanical merit if you expect to do all the work on it yourself; but if you expect to let somebody else do the work for you, choose the car that is represented by a dealer who is able and willing to give you honest service."

New Gains in War on Disease

Figures, not speculation, are the basis for recent statements that progress of the war against disease is more hopeful than ever before.

John K. Gore, Vice President and Actuary of the Prudential Insurance Company, finds that in the last quarter century science has saved 635,000 lives each year, and has prolonged life in thirty-two countries.

The Surgeon General of the United States, Dr. Hugh S. Cumming, recently reported that during the year ended June 30, 1927, there was a general decrease in the number of communicable diseases, and that America was free from epidemics and plagues. Research work for control of cancer, goiter, influenza, leprosy and malaria especially has shown encouraging results.

The fight against cancer was focused in a nation-wide campaign of education, with the coöperation of physicians and hospitals. Doctors say that this dread disease, which stands third as a cause of death in America, can be conquered if caught in its early stages.

Cracked walls easily fixed

IT'S so easy to make cracked walls or ceilings as good as new with Rutland Patching Plaster. You just mix with a little water and fill the crack or hole. Anyone can do it! No muss or bother.

Rutland Patching Plaster makes a perfect patch that's as lasting as the wall itself. It will not crack, crumble, shrink or fall out.

Paint, wall paper and hardware stores sell Rutland Patching Plaster. If your dealer hasn't it, we will mail a package direct and you can pay the postman 30c plus postage. Rutland Fire Clay Co., Dept. R-17, Rutland, Vermont. *Also makers of Rutland Roof Coating.*

Makes Ford a Tractor

We furnish everything for converting Ford Auto Chassis into Farm Tractor for truck growers, small farms, nurseries, etc. Pulls 16-in. Plow, Discs, Seeds, Cultivates; Runs Belt Machinery. We also build Garden Tractors and Cutter Bar Mower Attachments. Write for Free Particulars.
SHAW MFG. CO.
5701 Center St.
Galesburg, Kansas

Handles Easily. Turns in 15-ft. Circle.

See Miles Away! with Big 3½ Ft. Telescope

5 DAY TRIAL

5 Sections 8-Power

Brings distant people and objects close to your eyes. Wonder telescope opens over 3½ ft. long, 5 big sections, brass bound, 8-power lenses. Ideal for sports, camping, travel.

Read numbers on freight car mile away.—A. G. Palmer.

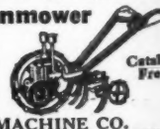
FREE CARRYING CASE AND SHOULDER STRAP

SEND NO MONEY

On arrival pay postman $1.85, plus postage (2 for $3.50). Or send $1.85 and we pay postage. Try 5 days. Money refunded if not delighted. Send today.
FERRY & CO., DEPT. 1787 CHICAGO, U. S. A.

KINKADE GARDEN TRACTOR
and Power Lawnmower

A Practical Proven Power Cultivator for Gardeners, Suburbanites, Truckers, Florists, Nurserymen, Fruit Growers, Country Estates and Poultrymen.



Catalog Free

AMERICAN FARM MACHINE CO.
1072 33rd Ave. S. E. MINNEAPOLIS, MINN.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

NOW ONLY $2.00

Giant Chest Expander and Progressive Exerciser

Be a muscular marvel. Have the muscles of a superman. Become strong for your health's sake or to astound your friends with extraordinary feats which only men of giant strength can do. In a few short weeks you will easily do stunts which now seem difficult --then real muscles and strength will be yours--and yours to keep. If you want exercise to just keep in good shape you can reduce the strength of the Progressive Exerciser by eliminating as many cables as you wish. If you want great resistance so as to build up big solid muscles, then use the full strength.

Send No Money Use This Money Saving Coupon

HOW IT IS MADE

Made of new, live, springy rubber so as to give it long wearing and great resisting qualities. Do not pay more for an exerciser that has forty or less rubber strands to each cable. Get the best and most durable. The Giant Progressive Exerciser has 50 strands of the finest rubber procurable to each cable.

FREE INSTRUCTIONS

We do not think it enough to send you an exerciser worth double what we ask, and for a limited time, we will also include instructions absolutely free. These instructions are interesting and simple to follow.

YOUR GUARANTEE

The Giant Chest Expander is sold with a guarantee that you will say it is the finest you ever saw or your money back.

5 Cables for $2 — or double strength — The double strength exerciser has resistance of over 200 lbs. — 10 Cables for $4

HOW TO ORDER--SEND NO MONEY

Sign your name and address to coupon below and get your Giant Exerciser at the present low introductory price by return mail. The price is made low because we want everyone to enjoy muscles and strength at the lowest possible cost. Don't pay more--order from us--get the most for your money. Use coupon now.

PROGRESSIVE EXERCISER CO.,
2003 Langdon Bldg.,
Broadway and Duane Street, New York.

Please send { } Your 10 cables { } Your 5 cables } Progressive Exerciser.
Check the Exerciser you want. It will be sent by return mail. Pay postman introductory price, plus few cents postage on arrival. If you are not entirely satisfied with your exerciser you may return it within 5 days and get your money back.

Name.....
Street.....
City..... State.....
If you live outside the United States send cash with order.

AGENTS This Money-making Invention is paying our Men a Fortune!

Here's your opportunity to make real money! My patented double edge razor blade stropper is sweeping the country with the biggest and easiest sales that have ever been made by agents. It sharpens all edges of the blade without removing the blade. It permits men to enjoy 500 clean satisfactory shaves from a single razor blade. This appeal of economy and practicability gets quick customers and many friends for you. It sharpens with a true diagonal stroke giving the blade the same keen edge the barber gives razors he strops. It retails for only $2 and pays you 100% commission on each and every one you sell. The double edge has been a steady seller from the minute it was put on the market. V. Fisher of Arlington, N. J., sold 12 in 16 minutes--L. Storr of St. Louis sold 36 the first day and H. Gardner of Chicago sold one gross the first week. This gives you an idea of the big profits you can make.

TESTED SALES PLANS FREE

Don't send me a single cent. All I ask is that you send me your name and address and receive my literature which shows you the many tested plans that pave the way for a profitable all-year-round business. Write today. There is no obligation. Do it this very minute before you forget and miss out on this big paying proposition.

MORTON SALES COMPANY
Dept. 902, 10-15 46th Ave., Long Island City, New York

A definite program for getting ahead financially will be found on page four of this issue.

Is Lost Explorer Now Jungle God?

(*Continued from page 17*)

the lower reaches of the Xingu in a dugout, his little party might at any moment have been wiped out by a storm of poisoned arrows from the bows of ambushed Caiapos or Gavãoes.

But pulled off to the eastward they would have run into no such serious peril. They should have emerged many months since either on the Atlantic Coast at Bahia or at the mouth of the Amazon after a comparatively easy trip down the Araguaya.

Then what mishap has delayed them?

Let's reconstruct their subsequent adventures. Chopping their way painfully, a few miles a day, through vine-tangled jungles where even at noon the light is dim, they encounter no dangerous animals. Even a jaguar will not attack unless wounded and cornered.

BANDS of chattering monkeys pursue them overhead; gorgeous birds and butterflies flicker through the trees. Wild life all around them, but none of it is dangerous.

Hunger is needless, there is game on every hand. Malaria is not fatal. A novice might get lost; Col. Fawcett is equipped with compass and mapping paraphernalia and familiar with every trick of "jungle navigation."

So there remain only the Indians to be reckoned with.

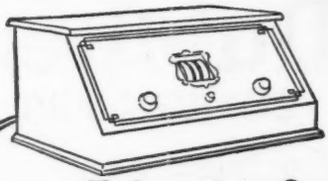
But these wild children of the jungle are less dangerous than the semicivilized tribes whose haunts Col. Fawcett has long since passed. As the Fawcett party proceeds naked warriors slink through the ferns to watch with childish curiosity these strange creatures. But the party plods methodically ahead and makes no offensive actions, and the Indians leave them alone. Fawcett is too wise in Indian psychology even to unsling his camera. A camera pointed at them will frighten them into belligerency. But if a monkey is shot for lunch, the sound scatters the trailing Indians in abject terror.

But as Fawcett penetrates farther into the jungles north of the River of Death his transport problem becomes inevitably more difficult. His mules are gradually perishing from hunger or disease. He awakes one morning to find that vampire bats have sucked so much blood from one animal that it must be killed. Later a pair of pack mules becomes hopelessly mired in a swamp. Fording a swift river, another is carried away and drowned. Descending a steep mud bank, one falls and breaks a leg. And when the pack train has dwindled to two or three, Fawcett's party, unable to continue, stops at an Indian village for native helpers.

AND here arises the disastrous mistake in Fawcett's plans. He announced before he left that when he came to dealings with the Indians he would play upon their superstitions to persuade them that he and his companions were supernatural creatures endowed with magic power. While among them he has used his rifle, surveying instruments, matches, compass and flashlights to arouse their fascinated superstitions.

And then one day he and his companions awake in their wigwam to find that all their supplies have been stolen. They are helpless. Their Indian hosts have become so impressed by the magic power of these white gods that they have taken steps to keep them permanently in the village. Thus the whole tribe will share in the magic, become all-powerful in war and the chase, and be freed from the terrors of Nature, like thunder and lightning.

It is the historic hobby of these Brazilian Indians to make such prisoners. From the days of the early explorers, João Ramalho and Diogo Alvares, down to the year 1927, the instances of whites in captivity throughout this country are frequent. Recent cases are cited by the Brazilian (*Continued on page 140*)



Use an Extension Cord *on your* Loud Speaker!

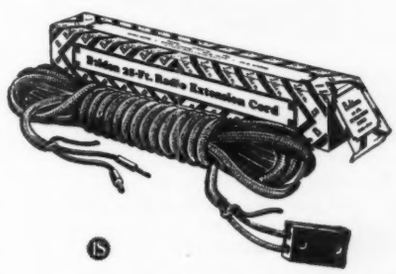
Most speakers are placed too near the radio receiver. With a Belden 25-ft. radio extension cord the speaker can be installed in the position giving best results.

It often is desirable to move the loud speaker to an adjoining room, on the porch or to a nearby bedroom. This is easily possible by using one or more Belden 25-foot extension cords which are provided with connectors that make the use of these cords a simple matter. No tools are required.

The individual conductors of the Belden Extension Cord are rubber covered and will withstand moisture and dampness.

The Colorubber insulation withstands the highest B voltages in radio receivers, hence the Belden Extension Cord transmits signals great distances from the receiver with the utmost clarity and with practically undiminished volume. Try one today.

Belden Manufacturing Co.
2304-A S. Western Ave., Chicago



Ⓘ

Specify **Belden**
Extension Cords

Ⓘ **This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.**

Dubilier
CONDENSERS

For High Voltage Circuits

Dubilier condensers are specified in the new Popular Science Electric Radio Set.

When building a new power amplifier remember Dubilier type 904. Or you can also use type PL-666 and type PL-667—1000 volts D. C. rating, supplied in either 2 mfd. or 4 mfd. sizes. This arrangement permits greater flexibility from both electrical and mechanical assembly standpoints.

Type PL-666

2 mfd. capacity—1000 volts D. C. rating

Type 907

For "By-Pass" Purposes Electrically Ideal

Our engineering department will gladly furnish wiring diagrams and full information for using Dubilier Condensers.

Dubilier Condenser Corp.
4377 Bronx Blvd., New York

Dubilier
CONDENSERS

Is Lost Explorer Now Jungle God?

(*Continued from page 139*)

ethnologist, E. Roquette-Pinto. Last summer I heard of cases near Juruena. The Indians' fondness for strange human beings, whether white or negro, resembles a child's affection for a toy. They cling to them and make tribal divinities of them.

Col. Fawcett sits presumably today in the door of a crude wigwam. Other wigwams are dotted about. Indian women crouch over the fires, roasting tapirs and monkeys; the men are off hunting, or practicing archery with hornets' nests for targets. The Colonel and his companions are under the ceaseless surveillance of a band of girls.

And what can the white men do? Try a violent escape? They can no more get out of that wilderness, once the Indians' animosity is aroused, than a cornered mouse can escape a cat. Col. Fawcett, knowing this all too well, can only wait patiently, hope for rescue, and continue to play his role of minor divinity.

He, with Jack Fawcett and Raleigh Rimmell, have become a pagan tribal trinity, and as such they are safe, well cared for, worshipped with weird rites and fed on outlandish dainties like iguana eggs and roasted ants and caterpillars. At night they watch the ceremonial dances, in which naked warriors, painted red and black and wearing gaudy feather headdresses, shuffle about the fires with a monotonous guttural chant.

I could describe their daily life in detail, for I was for a short time a similar captive-guest among the Carajas, on the Island of Bananal. The Araguaya River flowed by the village, and offered escape to the Amazon. In the wilderness north of the River of Death, Col. Fawcett has no such opportunity.

BUT now let's look ahead a few months. One morning as Col. Fawcett wanders about the village, he notices suddenly an alert restlessness among the Indians. Their wonderfully sensitive ears have caught a distant drone, faint but increasing, which in another moment he himself hears. The naked brown bodies become rigid; the black eyes probe apprehensively the jungle foliage. The drone becomes an appalling roar. The Indians perceive a monstrous white bird swooping low over the tree tops and singing a terrible song.

Instantly, with cries of abject horror, the entire population of the village flees into the fastnesses of the jungle. Fawcett and his companions, left unguarded, rush to a clearing, in a wild demonstration to catch the eye of the circling airman. Or, if there is no clearing, they raise smoke signals through the foliage. Commander Dyott's airplane has found them.

This is the only solution that I see to the mystery of Col. Fawcett's disappearance. It has been part of Commander Dyott's project from the start to use an airplane in his relief expedition. An overland party cannot pick up the trail; even Fawcett's camp sites will have been obliterated.

The scouting airman can detect the location of Indian villages—and they are not numerous—by definite signs. The wigwams will be obscured by foliage, but there will be a near-by clearing, a few dugout canoes and the smoke of fires rising through the foliage.

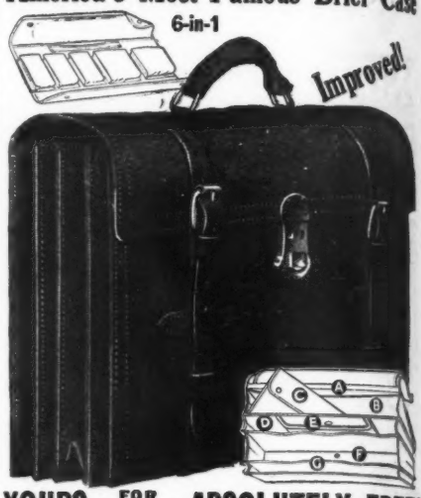
Spotting his villages, the airman will circle over them as I have suggested, and from one or another at last he will receive the signs that reveal Col. Fawcett's presence. The ground party, notified by radio or, if that is wanting, by the return of the plane, will push through to the village. And when it reaches the scene of Col. Fawcett's imprisonment, the plane will arrive again, sending the savages once more far into the jungle. And I can imagine Dyott striding up and paraphrasing Stanley's words:

"Col. Fawcett, I presume?"

SW

America's Most Famous Brief Case

6-in-1



YOURS FOR 10 DAYS ABSOLUTELY FREE!

NEW, IMPROVED "VERSATILE" now has 6 pockets instead of 5! No increase in price. Combines Brief Case, Week-End Case, Traveling Bag, Sample Case, Catalogue Case, Accountant's Case, —6 bags practically for the price of one. 17-inch size, top grain selected COWHIDE. Patented Steel Bar Construction prevents edges from sagging. Retains smart lines ALWAYS! COLORS:—Handsome Brown and Black.

(A) *Secret pocket, cleverly hidden; for valuable papers, bonds, reports, contracts, precious manuscripts, money, flask, etc.*
(B) *Pocket containing removable Toilet Kit.* (C) *Fold-up Toilet Kit. (See illustration over Brief Case.)*
(D) *Semi-stiff partition: for sketches, drawings, catalogues, magazines, stationery, order books, layouts, etc.*
(E) *Pouch Pocket for Pens, Pencils, Erasers, etc.*
(F) *Patented, disappearing flap—when pressed down, spreads bottom so that case STANDS UP as firmly as a suitcase. This flap also extends pocket (F) to great width for shirts, collars, socks, ties, extra trousers, underwear, etc.*
(G) *Utility pocket for odds and ends—6 pockets in all! You simply MUST see the "VERSATILE" Case to appreciate it.*

EXECUTIVES enthuse over "VERSATILE"

WE supply the "VERSATILE" to business men, bankers, traveling men, accountants, secretaries, salesmen, clergymen, architects, attorneys, teachers, students, etc. It is smart looking, "nobby" English tailored style. Stamps owner a person of importance. A real $20 Brief Case. Our "Direct-by-Mail" price to feature our LUGGAGE DIVISION is **$14.95**

Our Plan is Different!

Send NO Money! Pay NOTHING on delivery! Use "Versatile" Brief Case for 10 Days Trial ABSOLUTELY FREE! If pleased you may pay on Budget Plan:—

$4.00 MONTHLY

or, if you prefer to pay cash at end of 10 DAYS, deduct $1.20 and send check or Money Order for $13.75 in FULL SETTLEMENT. Otherwise return it. Order NOW. **$13.75**

SEAVER-WILLIAMS CO.
Importers, Exporters, International Mail-Order House "2 Generations of Honorable Dealings"
365 WASHINGTON ST., BOSTON, MASS.
Sole distributors of "Versatile" Brief Case

Gentlemen—Send me "Versatile" Brief Case for 10 Days' FREE TRIAL on "NO Money in Advance—NO Money on Delivery" Plan. Color desired_____

NAME_____

ADDRESS_____

Clip and mail this coupon NOW! If a new customer, please tell us something about yourself. We will appreciate and respect the information. THANK YOU! Pop. Science 3-28

$35 COMPLETE WITH MOTOR F.O.B. Chicago

15 Days Approval

Money Back Guarantee

18 TOOLS IN ONE

Greatest Machine You Ever Saw

The S&B 8-in. Combination Saw (18 tools in one) is the ideal machine for the shop, factory or the home; will rip, cross cut, bevel, miter, mortise, groove, drill, tenon, grind, rabbet, buff and polish. Motor is mounted on a base that is a part of the machine proper. Complete with attachments and price includes ½-H.P. Motor, 60-cycle, 110-volt A. C., run from any light socket. Shipping weight 100 lbs. **(Planer attachment to fit on table top will smooth pieces up to 2 in. wide, $12.00 extra.)**

Write for Complete Illustrated Folder

SCOTT-BANSBACH MACHINERY CO.
130 So. Clinton St., Dept. 64, Chicago, Ill.

Triumphs of Radio's "Hams"

(Continued from page 40)

Tonight? See you later—best regards." "Wouff hongs" annoyed the early operators. On the authority of the League, the name wouff hong is a typically garbled, unintelligible phrase from an inexpert dot and dash operator, and its real significance is the local interference that has all but disappeared with the abolition, except for emergency, of the old-fashioned, sputtering spark set. "Hams" conceived the wouff hong as a mythical, air-lurking beast whose staticlike growls disrupted transmission.

At last, in 1922, an American amateur, 1BCG, of Greenwich, Conn., transmitted the first amateur trans-Atlantic message, and ten other amateurs were also heard by eight British "hams"—all this with extremely low power—less than a kilowatt—and with grasshopper-sized antennae.

For the first time in history, on the evening of November 17, 1924, two amateurs on opposite sides of the Atlantic were talking with each other. Station 1MO, in West Hartford, Conn., heard a radio flash from Leon Deloy at station 8AB, in Nice, France. He replied and for two hours they conversed. Now the international amateurs use conventional signals, such as "QRK," meaning, "I am receiving well," while they brush up on their foreign languages.

IN 1925 Hiram Percy Maxim, noted inventor and President of the American Radio Relay League, went to France and suggested formation of the International Amateur Radio Union, which elected him its president. In November of that year the first international amateur call list was published.

Now new tests commenced. The amateurs had been relegated to what commercial companies considered waves of no value, such as those below two hundred meters. But these low waves in the amateurs' skillful hands proved the most efficient of all for long distance. The "hams" soon were able to use as short wave lengths as twenty to forty meters to talk around the world!

This was the stage setting when the International Radio Telegraphic Conference met recently in Washington, D. C., to settle all the new problems, and, incidentally, to decide the fate of amateurs. America knew the value of amateur radio, and the United States was the amateurs' friend. Secretary of Commerce Hoover commended them. Canada, Australia, and South Africa, where amateurs were powerful, were friendly. But broadcasting stations of other countries were greedy for the very waves the amateurs had developed.

THE Conference's recent decision is an amazing, unprecedented endorsement of the amateur. Now the radio amateur has international status and recognition. Radio "hams" the world over have the exclusive use of two of the most useful low wave bands, strips at their regular wave lengths of twenty and forty meters —which are forbidden to commercial and even to Government stations! Besides receiving the right to share two wide bands used largely for radio phones instead of dot-and-dash transmitters, amateurs are given, too, the free use of all waves below thirteen meters.

In this dark, unexplored region of radio they hope to make new advances as striking as those of the past. Already their international tests are under way with waves as short as five meters!

Through a countrywide investigation POPULAR SCIENCE MONTHLY is now able to present first-hand information upon the real status of amateur aviation. Read next month the facts disclosed by the first authoritative survey of the airplane's practical use as any man's business or pleasure vehicle.

·VALUE· ·ADVANCEMENT· ·TONE·

Judge the Radio Receiver you are about to buy, on these Three Essentials!

1 Value

A beautifully toned receiver for as little as $65.00

Do not confuse the Day-Fan Junior at this remarkable price with any other receiver on the market, because you will find by listening to it that the tone quality, even of this small instrument is distinctively Day-Fan—which means the voice of the speaker, the sound of the musical instrument—"like opening the door of the studio while the broadcasting is going on."

2 Advancement

A good sign of which is in the answer to the question, "How do they eliminate batteries?"

Not only does Day-Fan eliminate batteries by the use of AC tubes, but also by an entirely new method—a small compact motor and generator connected with the light socket. With this equipment you can go off and leave your radio for six months at a time—and when you come home, just turn it on, and in floods the broadcasting. They say Day-Fan is a year ahead —hear one of the many models yourself and you will know why!

3 Tone

Each star on this map is a great broadcasting station using a Day-Fan Radio to test the tone of the programs it is sending out.

Does anyone know as much about radio as the broadcasting stations that produce it? Day-Fan is their choice.

Judge the radio receiver you are about to buy on these three essentials, so that you can get from your radio equipment the full joy of the great broadcasting which is now on the air. Booklet on request. Address

DAY-FAN ELECTRIC CO.
Dept. P. S. 7 Dayton, Ohio

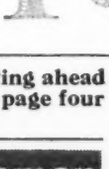
Day-Fan

The Radio Receiver Used by Great Broadcasting Stations to Test the Tone of Their Own Programs

A definite program for getting ahead financially will be found on page four of this issue.

Be a Radio Salesman

Earn $3,000 to $10,000



Over 10,000 music and radio stores all over the U. S. need trained men to sell new electric phonographs and radios, greatest musical inventions of the age. We guarantee to teach you by home-study course. Men trained by us now earn $3,000 to $10,000 a year. We put you in touch with positions all over U. S. Fascinating work. No previous experience necessary. Your training under personal direction of C. H. Mansfield, for 15 years one of the most successful and best known sales managers of musical instruments in the U. S. Plan endorsed by leading phonograph manufacturers. Write today for FREE folder "Rich Return from Radio and Phonograph Salesmanship," and details of positions now open.

Radio and Phonograph Salesmanship Institute
1031 So. Broadway Dept. 4 Los Angeles, Calif.

Improves-

tone fidelity, clarity, sensitivity—by automatically keeping tube filament voltage constant, despite "A" battery variations.

AMPERITE

REG U S PAT OFF

The "SELF-ADJUSTING" *Rheostat*

eliminates hand rheostats. Simplifies wiring, tuning, panel design. Particularly essential with Battery Eliminators. Accept only Amperite. $1.10 mounted (U.S.A.)

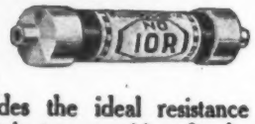
FREE—"Amperite Book" of latest circuits and construction data. Write Dept. PS—3

RADIALL CO.
50 Franklin St., New York

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Proven Parts That Are Popular With Set Builders

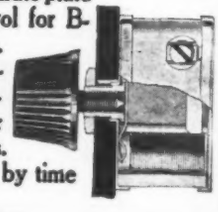
Bradleyunit-A



provides the ideal resistance for B-eliminators requiring fixed resistors of permanent resistance value. Not affected by age, temperature or humidity. Will not deteriorate in service.

Bradleyohm-E

provides accurate plate voltage control for B-eliminators. Used extensively by B-eliminator manufacturers. Not affected by time or moisture.



Bradleyleak

A variable grid leak that assures the ideal grid leak value. Easily installed on any set. Enables operator to get the best possible results with any tube.

Bradleystat

This pioneer in filament control of radio tubes is still mighty popular. Provides noiseless, stepless filament control for all tubes. Try a Bradleystat on your next set.

Allen-Bradley Co.
Electric Controlling Apparatus
MILWAUKEE, WISCONSIN

He Rebuilt His House and Saved $6000

(Continued from page 72)

two and a quarter inches wide, the usual random lengths. Of course I put on the oak at right angles to the old boards. As to thickness, I used seven-eighths-inch downstairs and half-inch upstairs. The thinner stuff upstairs was not to save money but to avoid too much pounding lest it damage the plaster ceilings below. Oak is tough and takes some hammering."

"I guess you used the regular flooring nails?"

"No, I got square-cut galvanized nails, eightpenny for downstairs and fourpenny for up. Square nails are more difficult to handle and to avoid splitting the wood, but they hold better. After the floors were laid, I scraped them by hand, put on two coats of shellac and finished with wax. Incidentally, I saved about two cents a square foot on my oak by buying it in winter when the lumber trade is slack and prices are lower. This saving paid for the material in one room."

"HOW about that old plaster you were afraid to jar?"

"Oh, that lime plaster is more solid than you'd think. It hangs together because of the hair it contains and it is about twice as thick as a good deal of modern plaster. It runs to an inch and a half. It will stay for another generation or two.

"The roofing is asphalt shingle over two-ply asphalt roll roofing with sheathing boards underneath.

"I took out the old warm air furnace and put in a steam boiler with a single pipe return system. It serves both families. A water heating device is connected with it.

"We have two electric voltages, 220 and 110. The former is metered separately for electric stoves—each family has one—and for other power uses, like a washing machine. You know there is a special low rate for a power line. The lower voltage takes care of the lighting and has its own meter. All electric and heating bills are divided."

To bring water to the house from a main 600 feet distant, the water company asked a dollar a foot for digging trench and about the same for two-inch pipe. (The extra size of pipe allows for distance and for future contingencies.) The owner decided that a little pick-and-shovel work would be agreeable and credited himself with a saving of $600. He bought galvanized pipe and connected it himself. It cost less than $300. The total saving was $900. However, it must be said that the water company pipe, being a new alloy cast iron, is a superior material.

A TWO-CAR garage with cement floor and with steam heat, light and water obtained from the house, completed the improvements. A builder estimated the garage to cost $720. The owner did it himself for $120, partly by using surplus material that had been lying around.

"Some day," I said, "there may be an argument over the coal and electric bills."

Joseph Penka laughed. "I expected that one. The steam pipes are laid out so that, on short notice, I could put in another boiler and let the other family do what they pleased. It is the same with the electrical wiring. I can have separate meters installed."

Perfumed Anesthetic Is Latest

ETHER masks scented with perfume are the latest surgical novelty, according to Dr. Gohrbrandt, German physician. The nauseating smell of the anesthetic is said to be eliminated, and the patients go quietly to sleep in comfort.

Women, particularly blondes, are as a rule much better at receiving anesthesia than men, declares an American dental expert.

"WANTED —A Clarinet Player"

Today the demand for clarinetists exceeds all others. When you can play a clarinet there's a good position ready for you—and real fun! Take this joy, pleasure and spare time profits this year, playing a clarinet. It's easy to learn to play a

PAN-AMERICAN

A few lessons and you can play a tune. Directly you are ready for a band or orchestra. Delightful for intimate fireside concerts. Be a leader by playing the clarinet, the "violin of the band."

PLAY—a PAN-AMERICAN, the only high-grade, factory guaranteed clarinet made which is moderate in price, to fit your pocketbook. Free trial offer and an easy payment plan to suit you—WRITE TODAY!

Pan-American Band Instrument and Case Co.
Elkhart, Indiana

Pan-American Band Inst. & Case Co., Dept. M-1, Elkhart, Indiana
Please send me illustrated catalog and details on (name of instrument) _____, without obligation to me.
Name.....
Street.....
City & State.....

. . . and then the program stopped!

RIGHT in the middle of the Eveready Hour. A good program. And then . . . nothing! I got my flashlight and went over everything. Found a broken lead-in. Fixed it. Everything jake again.

I wouldn't know what to do without a good flashlight. And I wouldn't use anything but genuine Eveready Batteries—the same make I have on my "B" circuit. Eveready Batteries make a flashlight come through with *light*, every time.

Get the flashlight habit. It's scientific . . . and sensible!

The Handy Tool for the Handy Man

TORIT TORCH NO 23
TIP 24, MEDIUM FLAME
TIP 28, LARGE FLAME
TIP 20, FOR RADIATOR & BATTERY WORK
TIP 23, FOR HEATING SOLDERING COPPER
SOLDERING COPPER USE WITH TIP NO 23
ADAPTER - E USE WITH TIPS 20-28

TORIT TORCH No. 23

connected to your Presto auto tank will do soldering, radiator repairing, lead burning, and numerous small jobs. No fussing and no lost time. Uses acetylene only. No air or oxygen necessary. Torch No. 23 with four tips, soldering copper, hose and connection for Presto auto tank: **$7.50**

ST. PAUL WELDING & MFG. CO. 169 W. 3d St., St. Paul, Minn.

Romance Jams the Log Jams

(Continued from page 25)

lumberjack for camp—were neither so tough nor so heroic as the lumberjacks of fiction. River driving is a business, not a melodrama. It's a colorful and often an exciting business, but it's a business built on these three solid facts: Water will run downhill. Logs will float. With anything like decent water conditions, logs can be driven from the woods to the mills a lot cheaper than any railroad could carry them.

The business men at mahogany desks in steam-heated offices in Montreal and Portland and New York who pull the strings that send millions of logs rushing down northern rivers on the freshets of May and June do not think log driving is a declining business. Each year the woods crews must go deeper into the back country for their logs, so the tendency is toward longer drives and more efficient drives—drives that move faster and leave fewer logs stranded. Each year many thousands of dollars are spent improving the rivers that carry their drives—blasting away troublesome boulders, and building heavy crib work to keep the logs running free in the channels.

BUT about these dollar-and-cents details the lumberjack refuses to fret his carefree soul. He toils and eats his beans with a mighty appetite, and when the drive is down spends his pay in the time-honored fashion of his kind.

Conditions vary with localities, but in New England and eastern Canada the cutting crews fell trees from September until spring.

When winter snow makes what old Joe calls "good slippin'" for sled runners, teams haul great loads of the logs to the frozen streams. Some are "landed" on the ice; more are piled in great "rollways" on the steep banks. When spring comes the break-up of the ice carries out the "landed" logs. Breaking out the rollways is a dangerous and spectacular performance that demands a clear head, quick wits, and agile body. Many a lumberjack has died in an unexpected cascade of logs.

"I mind once," said old Joe, "I was pokin' away at the key log of a rollway and she wouldn't budge. I got mad and hooked my peavy into that old log and pulled for all I was worth. Out she came and the whole kit and caboodle of logs came down on top of me. Get hurt? Not me! Not a one of them tetched me. While the boys were lookin' for my remains down on the bank, I climbed up and hollered to them. Most surprised bunch ever I seen."

Most interesting is the Androscoggin River drive that starts in the Rangeley Lakes district of Maine and ends at the mills of Berlin, New Hampshire. It isn't long as drives go, but in its fifty-odd miles it includes almost every variety of log driving.

THE bulk of the logs handled on this drive are cut on the shores of Lower Richardson Lake, southernmost of the beautiful Rangeley chain of lakes. These logs are chained into great rafts and towed down the lake into Rapid River. Old Joe took me to see the logs sluiced through the dam into the river. The blue water of the lake was carpeted for the space of several city blocks with bobbing logs confined and controlled by long booms of logs chained end to end. Over this shifting floor lumberjacks gay with bright checked shirts skipped nimbly, the calks—half-inch steel spikes—of their driving boots giving them momentary footholds. On the dam other lumberjacks, armed with pickpoles, waited.

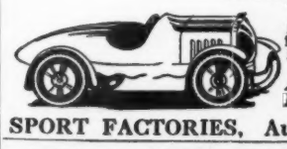
Then the sluice-gate was raised, and the lake water, a good seven feet above its normal level, rushed through the narrow opening and leaped roaring twenty feet down to the rocky bed of Rapid River. On this water rode the vanguard of the drive—four-foot pulp logs that were carried down like (Continued on page 151)

FACTORY PRICES-SAVE $'s
Choice of beautiful cabinets offered
TRY IT 30 DAYS IN YOUR HOME BEFORE YOU BUY
ALL METAL SHIELDED CHASSIS
3 Year Guarantee
8 tube one dial
MIRACO
TRADE MARK REGISTERED
Only 69.75
Retail List Completely Assembled
MAGNIFICENT TONE-SUPER SELECTIVE-POWERFUL DISTANCE GETTER
All Electrified or Battery Set!
America's big, old, reliable Radio Corporation (8th successful year) guarantees in its big, powerful, latest 6, 7 and 8 tube Miraco sets to offer unsurpassed value. Unless 30 days' use in your home fully satisfies you with the Miraco's beautiful clear cathedral tone, razor-edge selectivity, powerful distance reception, easy operation, etc. —don't buy it! Your verdict final. Save or make lots of money on sets and equipment—write for testimony of nearby users and Amazing Special Factory Offer.
Miraco's work equally fine with "AC" electric house light socket equipment or with batteries. Take your choice. Many thousands of Miraco users—who bought after thorough comparisons—enjoy programs Coast to Coast, Canada to Mexico, good and clear—with magnificent cathedral tone quality. Don't confuse Miraco's with cheap radios. Miraco's have finest parts, latest approved shielding, metal chassis, etc.—as used in many $200 sets.
DEAL DIRECT WITH BIG FACTORY
Your Miraco reaches you completely assembled, rigidly tested, fully guaranteed. Easy to connect and operate. 30 days' trial. 5-year-guarantee if you buy. You take no risk, you insure satisfaction, you enjoy rock-bottom money-saving prices by dealing direct with one of radio's oldest, most successful builders of fine sets. 8th successful year.
Yes! Big Discounts to User-Agents
7 tube one dial METAL SHIELDED CHASSIS $49.75 RETAIL LIST
MIRACO "Powerplus" sets—6 and 7 tube models—have magnificently beautiful, clear cathedral tone quality. Turn one dial for stations everywhere. Ultra-selective. Latest all-metal shielded chassis. Illuminated dial. Fully guaranteed. Try one 30 days! Big selection of beautiful cabinets.
Dealers Write! USER-AGENTS! Make big profits showing Miraco to friends. Get Our Special Wholesale Prices! MID-WEST RADIO CORPORATION, Cincinnati, O.
MIRACO Radio gets 'em Coast to Coast
USCAC REPORTS PROVE THAT
BEAUTIFULLY ILLUSTRATED CATALOG AND AMAZING SPECIAL OFFER
Free!
SEND NO MONEY—30 DAYS' TRIAL. Special Wholesale Price Offer to User-Agents, Bank References, testimony of nearby Miraco users—all the proof you want—sent with catalog.
mail coupon right now!
Electrify Any Radio with MIDWEST NO-BATTERY A.C. Light Socket Power Units SAVE $'s
"A", "B" and "C" power, direct from light socket, without batteries! Write for Midwest prices and discounts. Units are highest grade—lastingly dependable, quiet in operation, fully guaranteed. Mail coupon!
ANOTHER BIG BARGAIN! Famous powerful big Miraco Super 6, 1928 model—ultra selective! Thousands find it outperforms sets of much higher price. 30 Days' Trial Free. Fully Guaranteed.
6 tube Super $36.75 RETAIL LIST
MIDWEST RADIO CORP'N
Pioneer Builders of Sets
408-C Miraco Bldg., Cincinnati, Ohio.
THIS COUPON IS NOT AN ORDER
WITHOUT OBLIGATION, send me free literature, AMAZING SPECIAL WHOLESALE PRICE OFFER, testimony of nearby users, etc.
NAME
ADDRESS

Print Your Own

Cards, stationery, labels, paper, circulars, tags, menus, book etc. Save money and time, cut cost in half. Sold direct from factory. Pays for itself in a short time. **Complete Outfits, $8.85 up.** Job Press, $11, $29; Rotary $149. **Print for Others, Big Profits.** All easy, rules sent. Write for catalog of presses, type, paper, cards, envelopes, paper cutters. **The Kelsey Co., P-33, Meriden, Conn.**

Sport Bodies for Fords at FACTORY PRICES!



This Model in Grey Prime $39.50

Write for Booklet A-10 Showing Other Models.

SPORT FACTORIES, Aurora, Illinois

THIS 100 PAGE RADIO CATALOG FREE

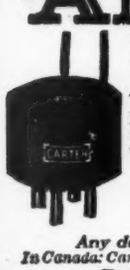
Contains 75 Radio "Hook Ups" 600 Illustrations Over 1,000 Articles

Special Proposition for Dealers Agents Set Builders

"Build your own with 'RASCO' Parts"

Radio Specialty Co., 96-P Park Place, New York, N.Y.

CARTER



New A. C. Adapters

For use in converting sets to A. C. operation. Again Carter leads.

Adapters for both Cx326 — Cx327 (type tubes) (type tubes) 90¢ $1.10

Any dealer can supply. In Canada: Carter Radio Co., Ltd., Toronto

MEMBER RMA Carter Radio Co. CHICAGO

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

MONEY-MAKING DEPARTMENT

$1.00 to $7.00 Per Hour for Your Full or Spare Time

Cash in Advance for Spare or Full time. $100 weekly easy with Carlton plan. NO investment. Free sample outfit. Amazing Men's Wear Values. Start at once. Write Carlton Mills, 114 Fifth Avenue, Dept. W-G., New York.

Superkeen! Amazing New Patented Magnetic Blade Sharpener. Sharpens Razor Blades Instantly. Magically, by Powerful Magnetic Force! New! Absolutely Different! Sensational Demonstration! Whirlwind Seller! Free Sample! SuperKeen, Inc., Salisbury, N.-C.

$12 Day Representing Big Harley Factory. Established 35 years. Sell friends, neighbors—groceries, extracts, family medicines, toilet preparations etc. Steady profitable repeat business. $3.00 hour part time. Samples furnished. Harley Company, Desk 37, Dayton, Ohio.

AGENTS MAKE $3.00 HOUR TAKING orders for 40 fascinating "Handy Things" for Kitchen. Sell on sight! Write General Products Co., Dept. SM-6, Newark, N. J.

Amazing New Glass Cleaner offers you $15 a day sure! Cleans windows, windowshields, show cases, etc., without water, soap or chamois. No muss. Easily demonstrated. Housewives, motorists, garages, stores, institutions buy on sight. Write for Special Introductory Offer. Jiffy Glass Cleaner Co., 1661-A Monmouth, Cincinnati, O.

Ladies! $36.00 weekly spare-time "pick up" money! Just show your friends 938 beautiful Priscilla Fabrics and Guaranteed Hosiery. Write A. Fitzcharles Drygoods, Trenton, N. J.

Every home needs this complete line of household specialty products. You supply the demand and reap big profits. Sample line free. Write today for your territory Handy-Helps Products, 958 Noble, Chicago.

Be a Real Estate Expert. $5,000-$15,000 yearly. Experience unnecessary. I'll teach you everything. Connect you with my chain of real estate experts. Write for FREE booklet. National Real Estate Institute, Dept. 500-M, Fort Smith, Ark.

New lines just out. Everything in hosiery, underwear and Rayon lingerie for men, women, children. Beautiful, irresistible Catalog and Samples now ready. New special big money plans. Cash bonus, service awards, rapid promotion. No capital needed. Choice territories going. Rush reply to World's Star Knitting Co., 113 Lake St., Bay City, Mich.

I'll pay men $100 a week for selling our tailored to measure all wool suits and overcoats at $23.50 and $31.50. Highest commissions. Extra Bonus for producers Large swatch samples free. W. Z. Gibson, Inc., 500 Throop St. Dept. Q-672, Chicago

Collect and Keep $6.00 Commission Each sale. 2 suits or suit and topcoat $27.95. Unusual qualities. Satisfaction guaranteed. Latest patterns. Extra Large Outfit Free. Deal Direct. LaSalle Gold Seal Clothes, 527 Broadway, Dept. 32, New York City.

No Experience Or Capital Needed. Sell Taylor RainProof Caps and Women's Hats to friends, neighbors, etc. Make $75.00 weekly. Expensive samples and outfit free. Taylor Cap Mfrs., Desk F-4, Cincinnati, Ohio.

Free Outfit With Actual Samples of Bostonian broadcloth gets quick sales for our nationally known Bostonian Shirts at three for $6.95, postage paid. Liberal cash commission of $1.50 on each order of three shirts earns big profits for you. Bostonian Mfg Co., Desk SM2, 72 Summer St., Boston, Mass., Established 1863.

$15 a Day Demonstrating Amazing New kind of men's hosiery for largest company in business. Powerful selling outfit Absolutely Free. Write for exclusive territory Superwear Hosiery Co., Desk C-90, Minneapolis, Minn.

Get 1000 money making opportunities from reliable firms Free. No obligation, send name and address. Salesology Magazine, 500 N. Dearborn, Desk B-13, Chicago, Ill.

$1,000.00 Reward if this is not the greatest money-making house to house proposition ever known. N.R.G. tablets wash clothes in 10 minutes without rubbing. Free Samples. N.R.G. Co., P232, W. Superior, Chicago.

Old estab. mfg. co. gives you credit; starts you in business (city or country) selling 228 widely known household necessities. Permanent business; steady customers; large profits. McConnon, Dept. TH2, Winona, Minn

Amazing offer to salesmen! Make $90 weekly selling men's made-to-measure suits—guaranteed for full year! Large swatches and outfit free. Write quick! Palmer Clothing Mfrs., Dept. JW-6, Chattanooga, Tenn.

Agents—Just Out! $8.88 for Men's Suits! Anyone can sell! Commission $3 in advance! Free Sales Kit! 888 Company, Dept. C-15, Fort Wayne, Ind.

America's Greatest Tailoring Line Free! 130 large Swatch Samples—All Wool—Tailored to Order—Union Made—Sensational low prices. Get outfit at once. Address Dept. 359, Goodwear, 844 W. Adams, Chicago.

Send 25 Cents for a $1.00 Pocket Cigar Lighter and learn how to make $10.00 a day Easy. Sells on sight. Particulars FREE. Rapid Mfg. Co., 799C Broadway, New York.

Why not sell us your spare time? $2.00 an hour, $19.70 daily easy full time. Introduce 12 months Guaranteed Hosiery—47 styles, 30 colors for men, women, children, including latest "Silk to Top" Ladies' Hose; Men's Fancies. No capital or experience needed—we furnish samples. Silk hose for your own use FREE. New Plan. Macochee Co., Park 9283, Cincinnati, O.

Agents! Men and Women. Make big money taking orders for our beautiful Dress Goods, Silks, Wash Fabrics. Handkerchiefs, Hosiery, Fancy Goods. 1000 samples furnished. The Natl. Imp. Co., Dept. C89, 573 Bway, N.Y.

Why work for others? Employ agents yourself. Make your own products. Toilet articles, household specialties, etc. 500% profit. Valuable booklet free. Nat'l Scientific Laboratories, 1925-W Broad, Richmond, Va.

Big Pay Every Day! Complete guaranteed line direct to wearer—dress shirts, work shirts, overalls, coveralls, work pants, sweaters, underwear, playsuits. $10-$25 daily! Experience unnecessary. Big outfit FREE! Nimrod Co., Dept. 58, 4922-28 Lincoln Ave., Chicago.

No Dull Times Selling Food. People must eat. Federal distributors make $3,000 yearly up. No capital, experience needed; guaranteed sales; unsold goods may be returned. We furnish sample case, license and Free Samples for customers. Sure repeat orders. Exclusive territory. Ask now! Federal Pure Food, R2311 Archer, Chicago.

Tailoring Salesmen: Selling Simpson's new $23.50 pure virgin wool suits, topcoats; commissions in advance; exclusive territory, big outfit 175 samples Free. J. B. Simpson, 843 Adams, Dept. 1461, Chicago, Ill.

District Salesmen. All wool, Union Made suits, topcoats, $23.50. Liberal advance commission, bonus. Write for expensive FREE outfit. Harvey Bros., Dept. 552, Chicago, Ill.

New Household Device washes - dries windows, sweeps, cleans walls, scrubs, mops. Costs less than brooms. Over half profit. Harpers, 530 Third St., Fairfield, Iowa.

New invention beats vacuum sweeper and all its attachments. Electricity unnecessary. All complete $2.95. Over 100% profit. Morgan, Mrg., 797 Grimes St., Fairfield, Iowa.

Get Our Free Outfit Offer. Wonderful line 350 fast-selling Household Necessities. Every home buys; $15 a day sure; car furnished American Products Co., 1662 Monmouth, Cincinnati, O.

Agents, $180 Month. Bonus Besides. Introduce finest line guaranteed hosiery. 126 styles, colors. For men, women, children. Finest pure thread Japanese Silk. All fancy combinations of silk and lisle. Novelty and Sport numbers, full fashioned, chiffon, wool, etc. Must wear 6 months or new hose free. New sales plan. Credit given. Auto furnished. Spare time satisfactory. Write for samples. Wilknit Hosiery Company, Dept. 1035, Greenfield, Ohio.

Business of your own! Proved earnings $65.00 week. Large company established 1887 supplies all capital. Wonderful opportunity for men of unquestioned standing in their community No traveling. Not stocks, insurance or books Write at once, and past business experience Fairbanks, Dept. 12-C, Oakley & Wabansia Ave., Chicago.

Amazing $12 page book—"Safe Counsel," tells the truth about sex. Explains the Laws of the Love-life. Scores of intimate subjects. 104 chapters, 121 illustrations. Send no money—Write for a copy We'll send our regular $4.00 Gift Edition. Pay postman only $1.98, plus postage upon arrival. Satisfaction guaranteed. Catalog Free. Herbert Wilson, 800 N. Clark Street, Chicago, Dept. 4700.

Bankrupt and Rummage Sales. Make $50 daily. We start you, furnishing everything. Permanent business. Free details. Distributors, Dept. 279, 429 W. Superior, Chicago.

We pay women $6.00 an hour to wear exquisite Fifth Avenue dresses and show them to friends and neighbors. Experience unnecessary. Write today to Fifth Avenue Styles, Dept. 1003, Scranton, Pa.

Married Women Wanted, spare time, liberal pay, for about two hours' work per week, absolute honesty required. Agents not wanted. Address Mr. O'Connor, 111 West 42nd, Dept. 5, New York City. Just say, "Tell me about your spare time offer" and state how your home is lighted—Gas—Electricity—or Oil.

Sell Men's Fine Suits (extra trousers free) for $16.95. Commission $4.00. $90 a week for you, also tailored pants, $3.95 ($5.00 value). Big extra commissions. Both sample outfits free if you write quick. Tru-Fit, B-3, 808 Broadway, New York.

Punchboard Salesmen Take Notice. New fascinating game "Excitement." Can be used all states. $200 weekly easy. One minute sales talk. Pay daily. Cigar Stores Novelty Co., Dept. PX, Peoria, Ill.

Free Want Ad Catalogue No. 33, over 1,000 publications. Many combination offers. Publishers rates, place anywhere. Brinckerhoff, Inc., 37 W. Van Buren, Chicago, Ill.

New Patented, Self-Feeding Pencil! Writes 45,000 words without refilling. Automatically shoots new lead in place when needed. Handsomely made with eraser and patented pocket clip. Extra box of leads free if you order now. Pin one dollar to name and address and receive yours by return mail. Gifford Parks, 347 Lincoln Place, Brooklyn, N. Y.

IF IT'S NOT HERE WRITE US!

Here is a new service for the convenience of our readers. If you are looking for certain articles not listed, write P. C. S. Information Dept., 9 East 46th St., New York. For each item to be investigated, please enclose 10c. to cover cost of postage.

Pick Your Money-Making Opportunities Now!

We are in touch with the best and most reliable schools in America.

If you are interested in art, engineering, electricity, radio, aviation, or any kind of business training, we will help you find what you want. Please enclose 10c. to cover cost of postage and receive advice of prominent school expert. Address School Dept., P.C.S., 9 East 46th St., New York.

TO SQUARE-DEAL ADVERTISERS ONLY

We refuse over $3,000 worth of questionable advertising every month.

But if you do business on the basis of "satisfaction or money back" write us.

For rates in this and other magazines address Publishers Classified Service, 9 East 46th St., New York.

$25.00 daily selling colored Raincoats and Slickers, Red, Blue, Green, etc., $2.95. Hat Free. Pay daily. Outfit Free. Elliott Bradley, 230 S. Wells, Dept. AF-3, Chicago.

Sell "Style Tailored" shirts and neckties direct to wearer at factory prices. Beginners earn $50 first week in spare time. $100 weekly full time easy. Selling outfit FREE. Howard Shirts, 1219R Van Buren, Chicago.

$4,931.50 Profit In 6 Months Made by Chas. Hickey; amazing scientific invention just out. Write Face-A-Light Mfg. Co., Dept. P-160, Mitchell, S. D.

Tailoring Men Best Selling Clothing Line. Latest style Suits or Topcoats, $17.50—Commission $4.00 in advance. Bonus to Producers! Sample Kit Free! Dorr Co., 21 West 3rd Street, New York.

Don't worry with small profits and unknown articles! Backed by tremendous national advertising, hundreds of Nogar salesmen are making $500 to $1,000 monthly Right Now. World's longest wearing suits, $12.50. Amazing wear demonstration makes big, steady sales certain. Write today for Free Kit, full starting instructions. Nogar Clothing Mfg. Co., Dept. CS-3, Reading, Pa.

Agents—$300 Month. Sell Guaranteed Silk Hosiery. Must wear 7 months or replaced. New selling plan. We furnish auto. Free silk hosiery for your own use. Write for samples. Betterknit Textile Company, Silk, 635, Greenfield, Ohio.

POLMET POLISHING CLOTH.—Cleans all metals, gets enthusiastic attention, sells fast at 25c; sample free. F. C. Gale Co., 99 Edinboro St., Boston, Mass.

Women Representatives Wanted. New invention prevents shoulder straps slipping. No more discomfort. Women adore it. Write for particulars and free offer. Lingerie "Y" Company, 5 Lake St., North Windham, Conn.

Men, become Forest Rangers. Salary, $125-$200 month and home furnished; hunt, fish, trap, etc. For details, write Norton, 270 Temple Court, Denver, Colo.

We Start You Without A Dollar, Soaps, Extracts, Perfumes—Toilet Goods, experience unnecessary. Carnation Co. Dept. 593, St. Louis, Mo.

Sell Direct, Maker to Wearer, guaranteed boys and youths suits. Latest styles, popular prices. Commissions in advance. Experience unnecessary. Write for Free Sample Outfit. Craig-Wilson, 10 Waverly Place, N. Y.

Ankrum Advertising Agency, A20 W. Jackson Blvd., Chicago, Ill., specialists in direct selling, mail-order and poultry advertising. Service circular and catalog on request.

Agents; 500% Profit Free Samples Gold Sign Letters for Stores and office windows. Easily applied. Large demand everywhere. Metallic Letter Co., 431 N. Clark, Chicago.

DISTRICT MANAGERS

Producing Managers who know good tailoring and genuine value, write or wire for information. All wool and pure worsted suits and topcoats at $18.75 with $3.75 to salesman and 7% to manager. Outfits Free. One of the largest companies in America. We back every garment. Canterbury Tailors, Dept. M-7, 22 West 22nd Street, New York.

High grade managers with good sales records write us. We furnish finest shirt line in America. Sales outfits free to your men. Big doubled samples. Low prices but liberal commission arrangements! Tell us who you are and we will show you real cooperation. Gibraltar Shirt Corporation, AA 201 West 22nd Street, New York.

SCHOOLS

Home Study and Resident

Learn electricity at home through complete, practical courses written by well-known electrical engineers. Indorsed by Edison and Steinmetz. Write for Free Booklet. INTERNATIONAL CORRESPONDENCE SCHOOLS Dept. 1226, Scranton, Penna.

Learn Electricity in Los Angeles. Technical practical training qualifies you for responsible position. School established 1905. Approved by electrical industry. 17,000 successful graduates, Free booklet. Nat'l Electrical School, 4006-AX, So. Figueroa, Los Angeles, Calif.

Men, get Forest Ranger job; $125-$200 month and home furnished; hunt, fish, trap, etc. For details, write Norton, 270 Temple Court, Denver, Colo.

Big Pay Jobs open in Automotive field. Learn how on real equipment with real shop tools in eight weeks. Satisfaction guaranteed. Write quick for special tuition offer including board and railroad fare. McSweeney Auto Schools, Dept. 21-C, Cleveland, O. and Cincinnati, O.

Avoid those embarrassing mistakes in English by studying at home in spare time. New method shows you instinctively which word to use and how to use it. Write for Free Booklet. INTERNATIONAL CORRESPONDENCE SCHOOLS, Dept. 1225, Scranton, Penna.

Men qualify Forest Ranger Position; start $125 month; cabin and vacation. Patrol the forests; protect the game. Write Moksa, Dept. M-44, Denver, Colo.

Earn $25 Weekly. Spare Time, Writing for Newspapers, Magazines; exp. unnecessary. Copyright Book "How to Write for Pay" Free! 1307 Press Institute, St. Louis, Mo.

Prepare for an Art Career—thru the only school operated as a dept. of a large art and advertising service organization nationally known. For illustrated booklet, write Meyer Both Co., 1935 South Michigan Ave., Chicago, Ill.

Foreign Work: Men interested working romantic South America write at once for information. South American Service Bureau, 14,600 Aima, Detroit, Mich.

Want U. S. Gov't Position; commence $115-$250 month? Men-women, 18-55, trained at home in three weeks. Write Instruction Bureau, 137 Arcade Bldg., St. Louis, Mo.

Girls wanted for stage. Big pay. Learn stage dancing at home in spare time. Costs only a few cents a day. Write for free booklet. Veronine Vestoff, Studio C, 100 West 72nd Street, New York, N. Y.

Earn Money at Home, Full or Spare time. Oil Paint Photos. New Method. Easily Mastered. Highly Profitable. Oil Paint Outfit Free. Steady employment. Write, Free Book. Pictorial Art Studios, Inc., 2926 Broadway, Dept. S. M. C., Chicago.

Men-Women, 18-50, qualify for Forest Ranger, Ry. Mail Clerk, Special Agents, other Govt. Positions, $140-$200 month; write Instruction Bureau, 137 Arcade, St. Louis, Mo.

Learn Shorthand at Home! Amazing, new, easy way. Be a stenographer or secretary Earn $30.00 to $75.00 weekly. Become expert in five weeks spare time, without interfering with your regular job. Complete course reduced to $5.00 as special advertising offer. Only limited number of pupils accepted at this ridiculously low price, so mail a Five Dollar bill TODAY to St. Johns System, 418 St. Johns Place, Suite 2C, Brooklyn, N. Y. Money back if not satisfied.

MONEY SAVING DEPT.

"A bargain or your money back"

For special service, please mention name of this magazine when ordering

Send 25c for Five Issues of French Humor, a weekly magazine full of live, clean illustrations and jokes right from France. Newsstand price 50c, French Humor, 230 Fifth Ave., N. Y. C.

No more bother with "B" Batteries. Get perfect reception direct from light socket. Perfect Eliminator works on any type of set. Hooked up in one minute—works automatically No "extras" to buy. Thousands of enthusiastic users. Price only $4.95—less than a set of good "B" batteries. Send $1.00 with order. We ship C.O.D. for balance ($3.95 plus few cents postage) Carroll Sales Co., 3242 Boudinot, Cincinnati, Ohio.

Special until May 30th! Eleven pocket size detective books. Thrillingly "Valley of Missing Men," "Green Eyed Monster" and nine others only $1 for complete library while they last. Money refunded if not satisfactory. Fisher Printing Co., 793 Kearney, Arlington, N. J.

Two dollars' worth for one. Genuine Valet Auto Strop Razor with strop and blade in attractive gift box, only $1.00 postpaid. Act now and get big tube of New Quick Shave Cream free. Mail only $1 to Carter Distributors 3242 Boudinot, Cincinnati, Ohio.

If you need money and want to make it at home in spare time get my big illustrated book of 67 tested plans that show you how to start earning a profitable income without investment. Mail only half dollar (stamps or coin) to V. O. Fisher, 793 Kearney Ave., Arlington, N.J.

Man's or Woman's Fine Wrist Watch. Direct from Switzerland. Radium Dial, Jewelled Movement. Beautiful Silveroid Case. Cannot be manufactured in America for less than $12.00. We sell for only $3.99. Send no money. Pay on delivery. Money back if not delighted. Handell Company, St. Johns Place, Brooklyn, N. Y.

Dress Up! Get three beautiful Rayon Silk Ties in latest Parisian Patterns by mailing $1.00 to Fifth Avenue Cravats, 5th Ave. & 46th Street, New York City.

Glowing, Alluring, Artificial Pearls. Look like $100. Send name and address to Beauty Pearl Company, 365 Lincoln Place, Brooklyn, New York. Pay postman only $2.95 on arrival. Money back if not delighted.

Romance Jams the Log Jams

(Continued from page 143)

match sticks, long saw logs that crashed on the rock-strewn river bed, up-ended rebelliously for a moment, then too were carried helplessly on by the unleashed water. On the dam the men with pickpoles worked like demons to keep the logs end-on to the current and running free, for a sluiceway jam is the meanest sort. As the boom began to empty a windlass was manned, with much shouting and singing, and the boom logs drawn in toward shore, thus herding the outlying logs toward the sluiceway. Soon the desired number had passed through into the river, and the gate was lowered.

Following this section of the drive three miles down river, we found the logs floating quietly in deep water behind Middle Dam, and in charge of a new crew. There the sluicing process was repeated. Sometimes a single drive crew takes the logs from the woods to the mills, but on the Androscoggin drive, and on most other big ones, the dams divide the river into sections, each manned by its own crew, which hustles the logs to the next dam and then lets the other fellows do the worrying.

After six miles of the roughest sort of white water driving, Rapid River hurls the logs into Umbagog Lake and they are towed into the Androscoggin River. The logs are sluiced through several dams, and there is plenty of white water driving on the Androscoggin before they reach Berlin.

"I WAS at this drivin' game for forty years, until the rheumatism made me a has-been," volunteered old Joe as he spun the starter of the outboard motor and we started back across Umbagog. "It's a tough life, but it's hard to keep away from it. On the Androscoggin and the Diamonds I've driven logs—and on the big 'moccasin drive' up in the St. Maurice country in Quebec. They call it the moccasin because you never see a pair of calked boots on it. Those Canadians up that way like to do their driving from canoes and them there bateaus of theirs—big flat-bottomed boats something like a dory, but with higher bows and sterns, that can go whoopin' through the darndest rapids you ever saw without takin' in a drop of water. Those fellers—there's a lot of Indian blood in most of 'em—are the best white water boatmen you'll find anywhere. They can make a canoe sit up and talk.

"You been in that country? It's tough workin' there—dead cold in winter, and mosquitoes and black flies to drive you crazy in summer. Up there they don't call the forests the 'woods' or the 'brush.' They call 'em the 'bush.' Fellers say they're goin' into the bush just like a sailor says he's goin' to sea. And it's just as easy to get lost in the bush as it is to get lost at sea. I've heard a pack of wolves howlin' not ten miles from La Tuque, the biggest town there—the jumpin' off place for the bush. The same company that runs this drive here on the Androscoggin has a big pulp mill there, and owns timber limits up the St. Maurice.

"How do those companies know which logs belong to them? That's easy. A brand is cut in both ends of every log. Up above La Tuque the company I worked for has the first sorting gap on the river. A long boom stretches across the river, and in that boom there's left a narrow gap. There's a platform built there above water level, and men working on it work the logs crosswise to the current, so the cleats on the endless chain of a power conveyor pick them up. On a higher platform sorters look at the brands. Logs that have their company's brand they push off into the water, where they are held by booms until the pulp-crushers of the La Tuque mill need them. The conveyor throws the other logs back into the river below the booms, and they float on downstream.

"You say (Continued on page 152)

Electrical Experts are in Big Demand!
—L. L. Cooke

Look What These Cooke Trained Men are Earning

Makes $700 in 24 Days in Radio

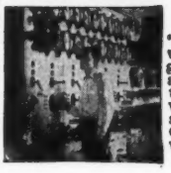
"Thanks to your interesting Course I made over $700 in 24 days in Radio. Of course, this is a little above the average but I run from $10 to $40 clear profit every day; you can see what your training has done for me."
FRED G. McNABB,
848 Spring St., Atlanta, Ga.

$70 to $80 a Week for Jacquot

"Now I am specializing in auto electricity and battery work and make from $70 to $80 a week and am just getting started. I don't believe there is another school in the world like yours. Your lessons are a real joy to study."
ROBERT JACQUOT,
2005 W. Colorado Ave.,
Colorado Springs, Colo.

$20 a Day for Schreck

"Use my name as a reference and depend on me as a booster. The biggest thing I ever did was answer your advertisement. I am averaging better than $500 a month from my own business now. I used to make $18 a week."
A. SCHRECK,
Phoenix, Ariz.



$3500 A Year For Beckett

"When I began with you I was just a common laborer, going from one job to another, working for anything I could get, and that wasn't much. Now my salary is $3500 a year and the Company furnishes me with an automobile."
C. O. BECKETT,
108 Maple Heights,
New Lexington, Ohio

See other letters telling of men's success in my FREE BOOK

I Will Train You at Home to fill a Big-Pay Job!

L. L. COOKE
Chief Engineer

It's a shame for you to earn $15 or $20 or $30 a week, when in the same six days as trained electrical man you could make $60 to $100—and do it easier—not work half so hard. Why then remain in the small-pay game, in a line of work that offers no chance, no big promotion, no big income? Fit yourself for a real job in the great electrical industry. I'll show you how.

Get Into ELECTRICITY

Learn to EARN **$60 to $100** a WEEK

Today even the ordinary Electrician—the "screw driver" kind—is making big money. But it's the trained man—the man who knows the whys and wherefores of Electricity who is picked out to "boss" the ordinary Electricians on jobs that pay $3000 to $5000 a year. Get in line for one of these "Big Jobs." Start by enrolling now for my easily learned, quickly grasped, right-up-to-the-minute, Spare-Time Home-Study Course in Practical Electricity.

Age or Lack of Experience No Drawback

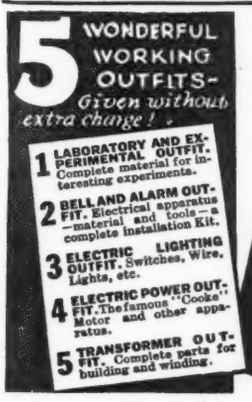
You don't have to be a College Man, you don't have to be a High School Graduate. I know exactly the kind of training you need and I will give you that training. My course in Electricity is simple, thorough and complete, and offers every man, regardless of age, education or previous experience, the chance to make from $60 to $100 a week.

No Extra Charge for Electrical Working Outfit

With me, you do practical work—at home. You start right in after your first few lessons to work at your profession in the regular way and make extra money in your spare time. For this you need tools, and I give them to you—5 big complete working outfits, with tools, measuring instruments and a real electric motor.

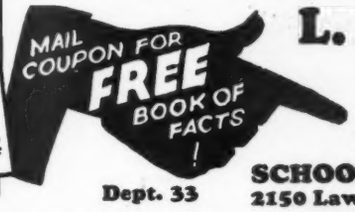
Satisfaction or Your Money Back

So sure am I that after studying with me, you, too, can get into the "big money" class in Electrical work, that I will agree in writing to return every single penny paid me in tuition, if, when you have finished my Course, you are not satisfied it was the best investment you ever made. And back of me in my guarantee, stands a $2,000,000 institution.


5 WONDERFUL WORKING OUTFITS—Given without extra charge!
1 LABORATORY AND EXPERIMENTAL OUTFIT. Complete material for interesting experiments.
2 BELL AND ALARM OUTFIT. Electrical apparatus—material and tools—a complete installation Kit.
3 ELECTRIC LIGHTING OUTFIT. Switches, Wire, Lights, etc.
4 ELECTRIC POWER OUTFIT. The famous "Cooke" Motor and other apparatus.
5 TRANSFORMER OUTFIT. Complete parts for building and winding.

Get Started Now—Mail Coupon

I want to send you my Electrical Book and Proof Lessons, both Free. These cost you nothing and you'll enjoy them. Make the start today for a bright future in Electricity. Send in Coupon—NOW.



L. L. COOKE
Chief Instruction Engineer
L. L. COOKE SCHOOL OF ELECTRICITY
2150 Lawrence Ave. Chicago
Dept. 33

L. L. COOKE, Chief Instruction Engineer, Dept. 33, 2150 Lawrence Ave., Chicago

Send me at once without obligation your big illustrated book and complete details of your Home Study Course in Electricity, including your outfit and employment service offers.

Name.....
Address.....
Occupation.....

Get into Aviation

Hinton

First Pilot to Fly Atlantic

Is Now Ready to train YOU at home

LIEUTENANT WALTER HINTON—pilot of the famous Transatlantic NC-4 flight—is ready to train you at home for a future in the greatest industry of the age. Through a Course that covers Aviation from A to Z—the cream of his broad experience and careful study—Hinton brings *you* the opportunity to quickly master the "ground work" of Aviation. He thoroughly trains you for any one of the fifty trades and professions upon which the Industry depends. No matter which branch you specialize in later, you must *know the fundamentals* of the business.
Hinton is ready to give them to you now —*quickly* and SUCCESSFULLY.

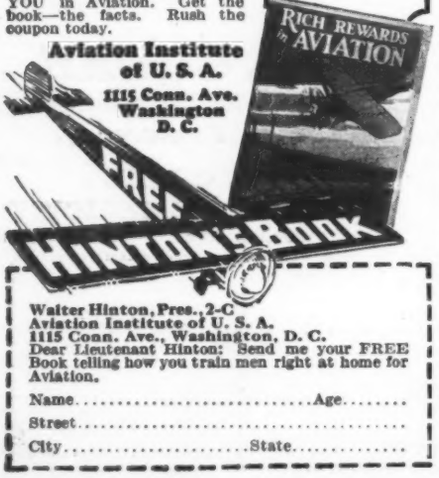
Better Jobs, Better Pay—on the Ground —in the Air →

Far-sighted men who get into Aviation *now* will grow up to the positions of foremen, superintendents, managers and PILOTS during its period of fastest development. Isn't it just plain COMMON SENSE for you to tie up with the Industry now—while the field is wide and open and BEFORE the best positions are filled?

Get Hinton's FREE Book

Send *now* for Hinton's FREE Book. Investigate his plan for putting his experience right into your hands, ready to use and turn into cash. Learn exactly *how* and *why* he can open up a wonderful future for YOU in Aviation. Get the book—the facts. Rush the coupon today.

Designers and Engineers
Pilots
Engine and Plane Mechanics
Riggers
Wire Workers
Electricians
Welders
Instrument Makers
Wood and Metal Workers
Draughtsmen
Plane and Motor Inspectors
Airport Operators
Radio Experts
Assemblymen
Aerial Survey and Photography
Aerial Transport Managers
Salesmen



Aviation Institute of U. S. A.
1115 Conn. Ave. Washington D. C.

Walter Hinton, Pres., 2-C
Aviation Institute of U. S. A.
1115 Conn. Ave., Washington, D. C.
Dear Lieutenant Hinton: Send me your FREE Book telling how you train men right at home for Aviation.

Name.....Age.....
Street.....
City.....State.....

Romance Jams the Log Jams

(*Continued from page 151*)

lumberjacks aren't what they used to be," I commented. "How are they different?"

"Well," said old Joe, "there's a different class of men in the business. Used to be a man was a lumberjack and nothin' else. He worked in the woods all winter, and on the drives in the spring, and then when he'd get paid off he'd go on a bender for a couple of weeks, and then loaf until September, and go into the woods owing the company money for his outfit. But a good many of the fellers that work on the drives now-a-days are just laborers from the big cities. They don't take any pride in their business. Get their money and get back to the cities.

"But the real lumberjacks still spend their money pretty freely. Some of them blow it on booze and a good time. But the younger fellers don't do that so much. Clothes is their delight. Say, some of 'em will come off the drives, and without waitin' to take a bath even will get rigged up in an outfit fit for a city dude. Maybe they're more moral than we used to be, but they ain't as good at breakin' down a jam, with the white water clutchin' at their legs, and death hangin' over their heads. No, sir!"

A New Brood of Lindberghs

(*Continued from page 30*)

with him and if they, too, report his case hopeless, he is "washed out."

Promotion to solo flying brings the reward of two flights a day—half an hour alone and then half an hour with the instructor, learning new maneuvers for the next day's practice.

The beginning of soloing brings the most thrilling experiences of all, but cadets are forbidden stunt flying. On a clear day this rule can be enforced easily enough, but when the clouds hang low it isn't so easy.

Along with his primary training in flight, the cadet has devoted part of each day to technical training on the ground. He has studied the airplane engine until he is thoroughly familiar with every part. He has mastered details of the rigging of airplanes. He has learned the principles of navigation and how to use navigating instruments. He knows how to send and receive signals by radio, and has practiced communication by hand and light signals and carrier pigeons. Even meteorology and some astronomy have been learned.

AT THE end of eight months he completes his primary training, and is a full-fledged flyer. There remain four months of intensive military training in the Advanced Flying School at Kelly Field, San Antonio. There he handles every type of service plane, from the speedy little pursuit ship to the giant multi-engined bomber. He practices military formations and evolutions, flying wing to wing with his comrades at 150 miles an hour. He flies through fog and storm, and tries his ingenuity at making forced landings in tight places. Perhaps, even, he experiences his first forced parachute jump, as did Lindbergh during his cadet days.

Not the least of his achievements is the ability to fire a machine gun and hit a target from his swiftly moving ship.

At the end of a year he has flown for more than 200 hours. He is an expert pilot, equipped to meet any emergency. Graduating, he receives the commission of second lieutenant in the Air Corps Reserve, subject always to the call to active duty, and is in line for a commission in the Air Corps of the Regular Army.

Whatever calling he may choose to follow, the year of strenuous effort and adventure has accomplished a two-fold purpose. It has raised him to a place of leadership in the ranks of aviation, and it has added new strength to the nation's air defenses.

Will You Accept a 1928 ATLAS

Given to readers of this magazine who take advantage of this offer now made in connection with

Webster's New International Dictionary

The Merriam Webster

The "Supreme Authority"

A complete reference library in dictionary form, with 3000 pages and type matter equivalent to a 15-volume encyclopedia, all in a single volume, can now be yours on the following remarkably easy terms:

The entire work (with 1928 ATLAS)

Delivered for $1.00

and easy monthly payments thereafter (on approved orders in United States and Canada). You will probably prefer the beautiful India-Paper Edition which is

Reduced About One-Half

in thickness and weight as compared with the Regular Paper Edition

over 408,000 Vocabulary Terms and in addition, **12,000 Biographical Names, nearly 32,000 Geographical Subjects, 3,000 pages, 6,000 illustrations.**

Constantly improved and kept up to date. "To have this work in the home is like sending the whole family to college." To have it in the office is to supply the answers to countless daily questions.

To These Who Send This Coupon NOW!

G. & C.
MERRIAM CO.
Dept. S, Springfield, Mass.

Please send me free of all obligation or expense, complete information, including "125 Interesting Questions" with references to their answers, striking "Facsimile Color Plate" of the new bindings, specimen pages of India and Regular paper with terms of your Special Atlas Offer on Webster's New International Dictionary to readers of Popular Science. [3-28]

Name.....

Address.....

25,000,000 AUTO OWNERS Need This NEW Device!

Earn $100 Weekly Selling Them!

Automotive engineers claim that 95% energy in gasoline is wasted. With the perfection of a new invention part of this waste gas is turned into added mileage and power. Think of the sales possibilities in offering this new Whirlwind invention that saves car owners hundreds of gallons of gas yearly. Amazing reports show up to

55 Miles on a Gallon of Gas

Owners also report more power, quick starting, instant pick-up and disappearance of carbon. Men are now being appointed in each locality to take care of the tremendous demand.

FREE SAMPLE

A Whirlwind Gas Saver is provided our workers free to enable them to equip their own car or carry for demonstration purposes. Send name and address today for this free sample and wonderful money making offer.

Get Territory Quick

Our men can easily make $5,000 to $6,000 yearly. Spare time workers make $20.00 and even more daily—You too can get this big money.

Whirlwind Mfg. Co.
999-188E. Third St.
Milwaukee, Wisconsin

Our Battleships on Wheels

(Continued from page 46)

soon afterward German shells began dropping about both.

The next clear day another German buzzard came over, and then we got a bad dose day and night for forty-eight hours or thereabout. Guns 4 and 5 got the worst of it. First the buzzard dropped bombs near 4, then the Germans resumed their bombardment of Belleville and its bridge over the Meuse, near our position. Some of the shells struck within twenty or thirty feet of our berthing cars.

NEXT day, the 28th, three of our men were badly wounded. It was now almost November, and the Meuse valley was rainy and raw. We were afraid weather had affected our powder. If it got too cold, it lost its punch and wouldn't drive the shells so far. We decided to steam heat the ammunition cars and Gun 5 started to try it out. Steam-fitters among their versatile crew started to lay a steam pipe line from the locomotive into an ammunition car. They were working out in the open when a shell landed and hit A. P. Sharpe, K. W. Guthrie and A. J. Burdette. We sent them to the Army hospital at Glorieux. Next day Sharpe died, first of the crews of our battleships on wheels to be killed by the Germans. The others recovered.

On the day Sharpe died his gun, 5, started with 3 and 4 to even up by firing ten shots each into a mass of German troops concentrating at Mangiennes, about 26,000 yards away. Next morning Gun 2, back from the Laon front, reached Charny, about three miles nearer the Germans than Thierville. From there we fired our first shots at Montmedy, six, at 37,382 yards. The gobs went through a German bombardment while firing. Shells landed between the gun and berthing cars and killed three American engineers working on our track. They blew the headquarters car and one berthing car off the track, but we got them back.

But there was fun, too. Souvenirs were plentiful. Pretty soon we began to look like a war museum. I got a derelict French box car and put a gob in charge who took all souvenirs and issued checks. Thank God, the Germans never hit that car.

Liberty parties brought little stoves from deserted Verdun. Everything was all right until an Army general came around inspecting and asked where the stoves came from.

"General," I said, "the weather is getting wintry. A few days ago we had a heavy storm, and it just rained stoves. We shut all doors and windows, but a few stoves blew in somehow."

The general said no more.

NOW Marshal Foch was planning another great thrust to envelop Metz and throw a French and American force under our old friend Mangin and Lieut. General R. L. Bullard into German Lorraine, and on to the Rhine. Guns 1 and 2 were sent south and were ready to shell two important railroad centers, Bensdorf and Saarburg, when the armistice came November 11.

That was because of the great success of the general offensive starting November 1, in which Guns 3, 4 and 5 played a valuable part. At dawn that morning they started firing, and Gun 2 joined in for a while. Eighty-one of our great shells fell that day upon the two vital junctions of Montmedy and Longuyon. The Germans tried to use the railroads to the utmost, in reinforcing their wavering front, and our shells fell just when and where they were needed.

We fired an even hundred next day. The doughboys had broken the German center, and were pushing straight for Sedan. Now or never they needed support, and our battleships on wheels gave it. We sent for more ammunition, and we got

(Continued on page 154)

3 Drafting Lessons Actually FREE!

to prove you can learn at home in spare time!

We have invented a new, simplified way to teach Drafting—the first real improvement in Drafting home-instruction in history. We want you to see it, try it—without one penny of cost or obligation. We want to show you how we get away from the *copying* methods used in the past. See how we make you *think*, solve problems, do actual drafting room jobs *from the first lesson!*

I will make this contract with you:

When you enroll for our home-training in Drafting, we agree to give you:

1. Complete Drafting training, by the new Practice-Method.
2. Professional Drafting Outfit, as illustrated.
3. *We will help you get a good Drafting position* at a substantial increase in pay.
4. Or we'll refund every cent of your money.

O. C. Miller
Director of Extension Work

Draftsmen WANTED!

70,000 fine jobs advertised this year, many at $60 to $125 a week. Get ready to fill one. Get out of the rut. Make something of yourself. Plan *your future* in Drafting. Even if you have only common schooling, even if you know nothing of Drafting, we guarantee to make you a real Draftsman *or to refund your money!* Special surprise offer right now to the first 500 men who answer this ad—reduced price, easy terms. Coupon brings complete information.

A new, rapid, simplified way

This new "Job-Method" gives you actual drafting-room jobs in a new one-step-at-a-time way. With *pictures* which you can understand almost without reading the "lessons." And that is why American School-trained Draftsmen can qualify for a good job at big pay when they graduate.

The American School, a million dollar *No-Profit* Educational Institution now offers men a *double* service—training for a specific job, then finding the job. For one small price, on terms of only $6 a month, you are now assured of definite benefits, both in position and salary.

Coupon brings complete details of this sensational offer!

5 HIGHWAYS TO SUCCESS!

The big money in Drafting goes to men who specialize in Machine Design, or Electrical Drafting, or Architectural Drafting, or Structural, or Automotive. It isn't enough merely to know *general* Drafting practice. You must know how to calculate and design and plan original work. You need many Engineering subjects to fill the kind of a Drafting position that pays $60 to $125 a week. The American School *now includes this specialized training in its Drafting course.*

Job Service *Free to Students and Graduates:*

THE AMERICAN SCHOOL now offers its students and graduates, without cost, the services of an efficient Employment Department which keeps in touch with the employers of Draftsmen all over the United States. *We have placed hundreds of men in good Drafting positions.* We have made this training so complete, so practical, so easy to master, that our students *are bound to make good.* And, so, because the demand for real Draftsmen continues to exceed the supply and because this training actually prepares men for good Drafting positions, *we back it with a Free Employment Service, free to employers, students, graduates.*

Professional Outfit Given

Fine, imported instruments help you learn Drafting easily and quickly. These standard quality, full size instruments, including board, table, triangles, T-square, ink, protractor, etc. given without extra charge to students.

COUPON *Brings 3 Lessons Free*

Get them. Test your own ability to learn Drafting and get ready for a fine job and big pay. Coupon also brings surprise offer, and complete information about your opportunities for success in Drafting. *MAIL IT TODAY!*

Chief Drafting Engineer
AMERICAN SCHOOL
Dept. D-375
Drexel Ave. & 58th St., Chicago

Rush 3 Free Drafting Lessons, surprise offer, complete information, money-back guarantee, etc., to prove I can become a real Draftsman at home in spare time.

Name.....

Street No.....

City.....State.....

Chief Drafting Engineer

American School Drexel Ave. and 58th St. Dept. D-375 Chicago, Ill.

"What's Andy Blair Doing Now?"

***Bill*—"Haven't you heard? He's the new sales-manager for Hess & Schoble and they say his salary is $7500 a year."**

***Tom*—"He certainly has come up fast. He wasn't getting over $50 a week the last time I saw him. How'd he do it?"**

***Bill*—"Took up a course with the I. C. S. and studied at night. That's why the old crowd hasn't seen so much of him in the last few years. I wish I'd had the sense to do it too. I'd be making more money right now if I had."**

Why don't *you* study and get ready for promotion too? We'll be glad to help you if you will only make the start. And the way to do that is easy.

Choose the work you like best in the coupon below; then mark and mail it to the International Correspondence Schools today. This doesn't obligate you in the least, but it will bring you information that will help to start you on a successful career. This is your opportunity. Don't let it slip by.

Mail the Coupon for Free Booklet

INTERNATIONAL CORRESPONDENCE SCHOOLS
"The Universal University"
Box 7665-E, Scranton, Penna.

Without cost or obligation, please send me a copy of your booklet, **"Who Wins and Why,"** and full particulars about the subject *before* which I have marked X:

- ☐ Industrial Management
- ☐ Personnel Management
- ☐ Traffic Management
- ☐ Accounting and C.P.A. Coaching
- ☐ Cost Accounting
- ☐ Bookkeeping
- ☐ Salesmanship
- ☐ Secretarial Work
- ☐ Spanish ☐ French
- ☐ Advertising
- ☐ Business Correspondence
- ☐ Show Card and Sign Lettering
- ☐ Stenography and Typing
- ☐ Civil Service
- ☐ Railway Mail Clerk
- ☐ Common School Subjects
- ☐ High School Subjects
- ☐ Magazine and Book Illustrator
- ☐ Cartooning

TECHNICAL AND INDUSTRIAL COURSES

- ☐ Electrical Engineer
- ☐ Electric Lighting
- ☐ Mechanical Engineer
- ☐ Mechanical Draftsman
- ☐ Machine Shop Practice
- ☐ Railroad Positions
- ☐ Gas Engine Operating
- ☐ Civil Engineer
- ☐ Surveying and Mapping
- ☐ Metallurgy ☐ Mining
- ☐ Steam Engineering ☐ Radio
- ☐ Architect
- ☐ Architects' Blueprints
- ☐ Contractor and Builder
- ☐ Architectural Draftsman
- ☐ Concrete Builder
- ☐ Structural Engineer
- ☐ Chemistry ☐ Pharmacy
- ☐ Automobile Work
- ☐ Airplane Engines
- ☐ Agriculture and Poultry
- ☐ Mathematics

Name.....

Street Address.....

City..... State.....

Occupation.....

If you reside in Canada, send this coupon to the International Correspondence Schools Canadian, Limited, Montreal

Developing Star Salesmen is my hobby!

No matter what you are doing now, you can earn $100 a week if you will let me show you how to sell tailored-to-measure all wool quality suits for $23.50 and $31.50. Complete selling outfit absolutely FREE. Liberal commissions paid in advance—extra bonus money—steady income from repeat orders. All you do is sell—we deliver and collect. A wonderful opportunity for ambitious men. Write NOW for choice territory.

W. Z. GIBSON, Inc., 500 Throop St., Dept. Q-521 Chicago

Our Battleships on Wheels

(Continued from page 153)

enough, though none too much. We had brought to France powder and shells for 300 shots by each gun, 1500 shots in all. We had fired nearly half and not all the rest was at the front.

On November 3, while Guns 1 and 2 were preparing to leave for the Metz attack, and 3 and 5 doing work necessary before firing again, there came a hurry call to fire on two smaller junctions at Louppy and Remoiville, respectively some 29,000 and 28,000 yards, where our aviators reported German troops concentrating. A German aviator over Gun 4 watched the whole process. That evening shells came close and fragments struck the headquarters car.

Gun 4 opened the ball between 1:30 and 3:50 the morning of November 4, dropping shells into Montmedy. German shells fell close again, and G. F. Burke was slightly wounded.

Meantime Gun 3 had sneaked up to Charny at two o'clock in the morning and fired fifty-six shots into the railroad yards and at the tunnel at Montmedy. Ensign W. C. Davis checked the aiming angles O. K., and Lieut. W. G. Smith, commanding Gun 3, was sure he had done something. He had. The lower yards at Montmedy were in flames. Our battleships on wheels were officially credited.

Brigadier General Hugh A. Drum, Chief of Staff of the First Army, wanted us especially to cave in the mouth of the tunnel. It was a small target, but on November 5 Gun 3 threw fifty shells into the town and yards. On November 6 ammunition was lacking. Next day the firing at our favorite target commenced again. Then came the beginning of the end. As General Pershing puts it:

"WE HAD cut the enemy's main line of communications. Recognizing that nothing but a cessation of hostilities could save his armies from complete disaster, he appealed for an immediate armistice on November 6."

But Marshal Foch didn't quite trust the enemy, and the Allied Armies kept closing their jaws and we kept on dropping our great shells into Longuyon, Montmedy and Mangiennes. We got off fifty-five shots and spent most of November 10 waiting for ammunition.

The next morning the war ended, and we sent over ten black periods to mark finis. They were all fired from Guns 4 and 5 upon Longuyon. Gun 5 stopped firing at 10:56, four minutes before the Armistice, Gun 4's last shot was fired two minutes later. Seaman James A. Kaffka worked the firing key. It was all figured out that the shell would land a few seconds before 11 o'clock, just under the wire. We gave the primer to Admiral Earle, who had first launched the idea of the battleships on wheels on November 12, 1917, just a day over one year before.

During our firing in the greatest American battle, there had never been an American airplane to spot for us. The Intelligence Service had sometimes sent us reports of results, and a German prisoner said he had seen one of our shells blow up a troop train, but as soon as possible we went to see results for ourselves.

Lieut. Hayden, a professor at the University of Michigan, on November 12 went over to Montmedy, through the German lines. The French people in Montmedy greeted him as their saviour after four years of captivity.

One shell had hit the headquarters of the Seventh German Army and killed or wounded twenty-eight of the staff.

We had hit the tunnel three times, but had been unable to cave it in. That was because the delayed action fuses had not yet come from the States. The next day Commander Bunkley and I went to Louppy and Remoiville and found

(Continued on page 155)

AUDELS ENGINEERS & MECHANICS GUIDES

Practical educators for all Engineers, Firemen, Machinists, Electricians and engineer students. Eight valuable, up-to-date Guides treating on the theory and practice of modern Engineering in all its branches.

A COMPLETE HOME STUDY COURSE AND REFERENCE LIBRARY

$1 $1 PER MO.

8 pocket numbers with Ready Reference Index. 8754 pages. 4750 illustrations. Easy to read. Highly endorsed. A good help in securing Engineer's License. Price $12; terms, $1 per month. Free Trial.

INFORMATION: — *In A Handy Form.* Answers to Your Questions and Problems. Here is a partial list of the subjects covered:— **Engine Principles, Valve Setting, Pumps, Corliss Engines, Uniflow Engines, Pumping Engines, Contractors Engines, Locomotives, Marine Engines, Turbine Engines, Gas Engines, Oil Engines, Indicators, Producers, Aviation, Steam, Fuel Economy, Boiler Construction, Firing, Oil Burners, Stokers, Boiler Repairs, Pipe Fitting, Heating, Refrigeration, Elevators, Dynamos, Motors, Lighting, Wiring, Electrical Diagrams, Radio, Electrical Reference and Calculations.**

SHIPPED FREE

Not a cent to pay until you see the books. No obligation to buy unless you are satisfied. Fill in coupon *in pencil.* Send now—today—get this standard library for Engineers and Mechanics.

FREE EXAMINATION COUPON

Theo. Audel & Co., 65 W. 23 St, N.Y. City
Send me AUDELS ENGINEERS AND MECHANICS GUIDES. 8 numbers, $12, for *free examination.* If satisfactory, I will send you $1 in 7 days, then $1 monthly until $12 is paid.

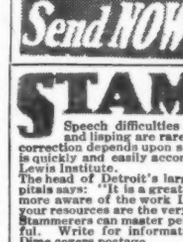
Name.....

Address.....

Occupation.....

Employed by..... 3T34

Make Big Money Learn Autos AT HOME!



If you're earning a cent less than $80 a week, send for my Free Auto Book. See how you can get complete instructional home, covering every branch of auto work. Learn how you can prepare for the Big opportunities—jobs paying up to $100 a week. Find out about this new, easy, practical "Job-Way"—about my Employment Service and the 4 big outfits you get. Write today, to:

B. W. COOKE, Directing Engineer
CHICAGO MOTOR TRAINING CORP.
Dept. 325 1916 Sunnyside Ave. Chicago, Ill.

Send NOW for FREE BOOK!

STAMMERING

Speech difficulties such as stammering, stuttering and lisping are rarely if ever outgrown. Permanent correction depends upon scientific re-educational training—and this is quickly and easily accomplished by methods employed only at The Lewis Institute.

The head of Detroit's largest, and one of the world's greatest, hospitals says: "It is a great shame that the medical profession is not more aware of the work Lewis Institute is doing. I am convinced your resources are the very best."

Stammerers can master perfect speech, win happiness and be successful. Write for information and special free phonograph record. Dime covers postage.

177 Stimson Ave. THE LEWIS INSTITUTE Detroit, Mich.

WE PAY $6 A DAY

STEADY AND SURE

taking orders for ZANOL Pure Food Products, Toilet Preparations, Soaps, Laundry and Household Necessities. 350 fast sellers. Nationally advertised. Everybody orders. Huge repeat business and profits. Not sold in stores. Big money for spare time. Ford Auto absolutely Free to workers. Write for particulars.

American Products Co. 193 Monmouth Ave., Cincinnati, Ohio.

Our Battleships on Wheels

(Continued from page 154)

fourteen shell holes about thirty-three feet in diameter and eight to eleven deep, two right in a former ammunition dump and most of the rest within effective reach of the railroad bridge midway between these two towns.

We had cut the main German strategic railroad in the decisive stage of the greatest battle in American or world history. General Pershing wrote me after the Armistice:

"Permit me to express to you and to the contingent that served the naval guns under you my sincere appreciation of the very efficient manner in which they coöperated with the artillery of the A. E. F.

"Your command has performed a distinctly important service, and I found you at all times eager to carry out our plans in a true spirit of coöperation.

"I should be very glad to have you express to all concerned my sincere thanks and appreciation for the work accomplished."

I PASSED on this praise with interest, to those who well deserved it, Commander Bunkley, Commander Schuyler and all the other officers and men who helped so loyally.

Well, the war was over. Now for Peace and Home. We went back to Haussimont and the night of November 23 we had a big movie show and on the spur of the moment, I talked a little to the men.

"After our experience," I said, "there will never come into my mind any question about the American manhood meeting any situation. After we had finished the Battle of St. Nazaire I knew this outfit would go to Berlin and nothing would stop them—but the Germans have given in and we are going home.

"In all our joys and gaieties, in connection with this performance here, we must not forget those men of this force who started out just as full of this as we did, but who have fallen by the wayside. It is not possible for a bunch of people to tackle all the things we have tackled without somebody getting hurt. But I am happy to say that all three of these men were hurt directly in the line of duty. They are:

"C. G. Russell, lost in Philadelphia.

"Thomas E. Price, died at Mailly from walking typhoid.

"A. P. Sharpe, killed at Thierville by a German shell.

"I ask you all to rise and sing with me that famous old hymn, 'Abide with Me.'"

One thing all those gobs wanted before they went home was a good look at Paris, and I thought they had it coming. The Parisians, too, wanted to see our big guns that they had heard about, so on November 28 my flagship train put off for St. Nazaire—via Paris—and the five gun trains came along after. We drew crowds that stared as if now they began to understand why the Germans had quit.

ON DECEMBER 11 all the trains had returned to our old battleground, St. Nazaire. Within a week all but one officer and twenty men, left to dismantle gun cars, were on the ocean homeward bound. With my executive officer, Commander Bunkley, and most of the men I reached New York Christmas Eve, 1918. My only regret was that I must say good-bye to so many true-hearted comrades who had made successful an enterprise such as few sailors ever undertook. One of my keenest pleasures now is in foregathering with one or another of them, as I often do.

I like to recall our inland voyage, and to remember that as a result of it, my country is the better prepared against attack in another war. For far at sea, a hostile fleet would be struck by shells of even greater power, fired an even greater distance by bigger guns, drawn by trains moving more swiftly—thanks to what we learned on the land cruise of our battleships on wheels.

MADE $1200.00 NET PROFIT IN 90 DAYS

You Can Do It Too FREE Book Tells How

SEND FOR THIS BOOK

HERE'S YOUR CHANCE!

The big opportunity you've always wanted—to make extra money, BIG MONEY, in your spare time, at home. W. T. Moore, Twin Falls, Idaho, made a net profit of $1200 in 90 days. You can do it too—turn every spare hour into $4 to $6 profit with the

IDEAL LAWN MOWER SHARPENER

You, too, can make yourself independent, build a permanent, honorable, big-paying business with this "Ideal" Grinder—a wonderfully simple machine that sharpens all makes of lawn mowers perfectly, scientifically, without taking the mowers apart. Just pick up the mower, set it in the "Ideal," make a few simple adjustments and proceed to sharpen. In 15 minutes the mower is ready for the lawn, and you have made $1.50 to $2.00—depending on the charge you fix.

$2100 LAST SEASON

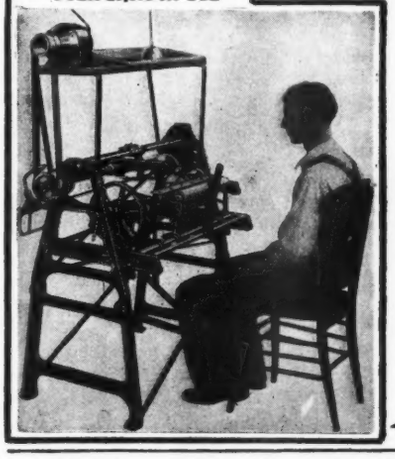
W. F. Kendt, Buffalo, writes: "I sharpened 994 lawn mowers last season and the receipts were nearly $2100 which is not bad for a side line."

$820 IN 55 DAYS

Zeno Brandon, Middletown, O., writes: "I made $820.70 in 55 days with my 'Ideal.' Have made as high as $38.70 in one day."

Man, It's Amazing How Easy it is to make big money with the "Ideal." Anyone can do it! H. J. Nulick, El Dorado, Kans., turned his grinder business over to his 14 year old son.

OVER 15,000 IN USE



Hundreds of Dull Mowers in your locality are waiting to be sharpened. No town too small. R. S. Newcomer, Vinton, Ia., writes: "People come for miles around and other towns to get their mowers ground." Your customers stay with you, too. The "Ideal" sharpens mowers to razor edge. Owners are delighted; tell their friends; your business grows by leaps and bounds.

You Make Money Right Away. Geo. E. Kearney, Stillwater, Minn., writes: "We set the machine up 2 weeks ago Friday; since that time have sharpened 102 mowers." That's close to $200 in Kearney's pocket for 2 weeks' work!

This Is Your Chance, Man! Make Us Prove It.

Our FREE BOOK, "Let George Say It" contains proof of what we say. Send today for it.

THE FATE-ROOT-HEATH CO., 718-744 Bell St., Plymouth, Ohio

SIGN and MAIL THIS TODAY

THE FATE-ROOT-HEATH CO.
718-744 Bell St., Plymouth, Ohio

You'll have to prove that I can make big money with the "Ideal" Grinder. Send me your FREE BOOK

Name.....

Address.....

A definite program for getting ahead financially will be found on page four of this issue.

Train at Home to **WIN OUT** *in business*

Do you want a better position and a higher salary? You can have these if you can do the work. LaSalle experts will show you how, guide you step by step to success and help solve your personal business problems through the time-saving LaSalle Problem Method. Our *salary-increasing plan* enables you to prepare during your spare hours, without interference with your present duties. Simply mark on the coupon the field in which you desire success, and we will mail you a valuable book describing the opportunities in that field, together with an outline of our *salary-increasing plan*. Also copy of "Ten Years' Promotion in One." There is no cost or obligation. Find out how the *salary-increasing plan* starts average men and women on the high road to success and financial independence. Check and mail the coupon NOW.

—Find Yourself Through LaSalle—

LA SALLE EXTENSION UNIVERSITY
The World's Largest Business Training Institution

Dept. 383-R Chicago

Tell me about your *salary-increasing plan* for my advancement in the business field checked. Send also copy of "Ten Years' Promotion in One," all without obligation.

- ☐ Business Management
- ☐ Modern Salesmanship
- ☐ Higher Accountancy
- ☐ Traffic Management
- ☐ Railway Station Management
- ☐ Law—Degree of LL.B.
- ☐ Commercial Law
- ☐ Industrial Management
- ☐ Banking and Finance
- ☐ Modern Business Correspondence
- ☐ Modern Foremanship
- ☐ Personnel Management
- ☐ Expert Bookkeeping
- ☐ Business English
- ☐ Commercial Spanish
- ☐ Effective Speaking
- ☐ C. P. A. Coaching
- ☐ Stenotypy
- ☐ Telegraphy
- ☐ Credit and Collection Correspondence

Name.....

Present Position.....

Address.....

A Great Book FREE

with this pay-raising library

For a short time only we will give every subscriber to the New Library of Machine Shop Practice a copy of French's Engineering Drawing—the greatest book on mechanical drawing ever written. This book makes drawing as plain as day—tells you all about instruments, plans and methods—and prepares you to handle any drawing job you will ever have to do. It comes to you absolutely free with

Machine Shop Practice

9 volumes—3065 pages—3608 illustrations
(A combined home study course and reference library)

The New Machine Shop Library was written for practical men. It gives you the best methods for every kind of machine shop work. It explains machine tools and their operation, drawing and design, tool work, gears and grinding, jigs and fixtures, automatic screw machines and their tools and all of the mathematics you will ever have to use. It is plainly written, completely illustrated—the very best kind of help to the machine shop man who wants to advance himself.

Send no money—
—Just mail the coupon

FREE EXAMINATION COUPON

McGRAW-HILL BOOK Co., Inc.,
370 Seventh Ave., New York

Send me for 10 days' free examination the New Library of Machine Shop Practice. If satisfactory, I will send you $2.50 in 10 days and $2.00 monthly until the special price of $22.50 is paid. If not wanted, I will return the books at your expense.

On receipt of my first payment it is understood that I am to receive, free of charge, a copy of French's Engineering Drawing.

Name.....

Address.....

City and State.....

Position.....

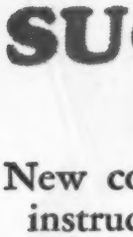
Company.....

PSM-3-28

Achieve SUCCESS in Radio

New course gives finest instruction obtainable

You Can Learn at Home!



R.L DUNCAN, Director, Radio Institute of America and author of several volumes in radio.

Good pay from the start, rapid advancement, and phenomenal success—a life profession of fascinating brainwork—that is what Radio holds for the man who knows his subject thoroughly. Since 1909 Radio Institute of America has trained thousands to become successful in the many branches of Radio. Are you going to plod along at a thirty-five dollar a week job when REAL MONEY is waiting for you in radio?

New Course Finest Ever

Prominent radio men have enthusiastically greeted RIA's new course as the most complete and up-to-date offered today. All this first-quality equipment is furnished FREE WITH THE COURSE—parts for making many practical radio circuits and the Peerless Signagraph for code instruction.

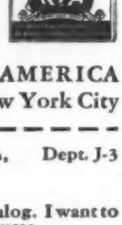
RIA backed by RCA, G-E and Westinghouse

You get all the benefits of instruction conducted by RCA and sponsored by RCA's associates, G-E and Westinghouse. Our employment department is at the service of graduates.

Study at Home!

Moreover you can STUDY AT HOME—when you please and as long as you please.

This new booklet describing the course is just off the press. If you want to learn more about the well paying positions in this fascinating profession send the coupon now for your copy.



RADIO INSTITUTE OF AMERICA
Dept. J-3 326 Broadway, New York City

RADIO INSTITUTE OF AMERICA, Dept. J-3
326 Broadway, New York City

Dear Mr. Duncan:

Please send me your new catalog. I want to know more about your new radio course.

Name.....

Address.....

.....

All Metal

(*Continued from page 20*)

hour, Jack Page figured he must have passed off the end of the point, and out to sea, long since. And he had.

The third hour of flight brought nothing of improvement. If the fog would only break for a second, merely give Jack a peek at the sun's position. . . .

Something else went wrong—Cheese came to a standing lean in the gangway and listened—Jack's heart stopped and his eyes went to the instrument board. "Trouble travels in mobs!" Jack barked. "The Liberty's burned out her generator!"

For a minute, the high note of the *Pacific Gull's* three-toned drone had fallen. Then, before the Liberty could quit entirely, Jack had switched her ignition over to "battery." For an hour or so, the motor would continue to operate on that source of supply. But, after that, with the Liberty "12's" twenty-four plugs sparking from one small battery, the juice supply would become exhausted; then the silenced motor, weighing at least 1500 pounds, with radiator and oil tanks, would become a heavy, useless thing.

WHEN the fourth hour ended, the sun was still among the missing; so was the Liberty, and it was "missing" badly. The dampness had gotten to its ignition, and the big motor vibrated and shimmied through every plate and rivet of the all metal *Gull*. Jack Page knew that motor wasn't going to be with him long. Also, he realized that to keep it running might mean damage to the gasoline feed-lines of the other motors. But to kill the Liberty meant to carry its dead weight. Then, with four hours' gasoline supply gone, the other two engines would operate only one more hour at the most. Jack came to an all metal, large-sized decision. He would try something that no other pilot had ever been put to: he decided not to carry that dead motor.

For a minute he and Cheese talked. Then the latter secured tools and took on a big job—a job of daring.

Cheese went through the small, forward cabin door and across the cat walk to the nacelle of the right wing's motor. Once there, he bellied down and unfastened the drift wire which ran upwards to the Liberty's radiator bed. Then, with the wing end of the drift wire, he made his way back to the ship and entwined the free bit of the line through the exhaust manifold. Meanwhile Jack was running all motors at half-speed.

NEXT, Cheese freed the four hold-down drift pins which held the motor bearers to the nose bulkhead. With the safeties freed, Cheese lightly tapped all four pins until they were ready to slide. Then, moving across to the left wing's nacelle, he loosened the second drift. And with this wire in hand, he returned to the left door of the cabin, crouched just inside, and waved an O.K. back to Jack.

Then Jack Page undertook the thing that no pilot had ever before tackled. He slowly eased full-power to his two wing motors and won a little more altitude. Next, even slower, he palmed the Liberty's throttle wide-open, and she vibrated beautifully! When the Liberty was shaking the ship as no ship had ever been rough-housed before, Cheese snapped the left drift wire forward and into the whirling propeller. With a sickening jolt, the propeller shattered and rattled its broken bits forty ways against the all metal surroundings. With a murderous vibration set up, the craft palsied wildly in every plate—seemed as though it must be torn to pieces. Another wrenching and tearing, and the thing was over. The Liberty had been shaken out! And the Pacific checked it in. Broken-blade vibration will do it every time.

(*Continued on page 157*)

Play the HAWAIIAN GUITAR Just as the Natives Do

FREE when you enroll $15 HAWAIIAN GUITAR and Case

Only 4 Motions used in playing this fascinating instrument. Our native Hawaiian instructors teach you to master them quickly. Pictures show how. Everything explained clearly.

Play in Half Hour After you get the four easy motions you play harmonious chords with very little practice. No previous musical knowledge necessary.

Easy Lessons Even if you don't know one note from another, the 52 printed lessons and the clear pictures make it easy to learn quickly. Pay as you play.

Free Guitar and Outfit in Genuine Seal Grain Fabrikoid Case as soon as you enroll. Nothing to buy—everything furnished. No delay.

Write at Once You'll never be lonesome with this beautiful Hawaiian Guitar. Write for Special Offer and easy terms. A postcard will do. Address

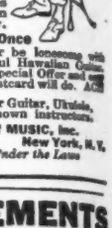
OTHER COURSES Tenor Banjo, Violin, Tiple, Tenor Guitar, Ukulele, Banjo Ukulele — under well-known instructors.

FIRST HAWAIIAN CONSERVATORY of MUSIC, Inc.
9th Floor, Woolworth Bldg., Dept. 146, New York, N. Y.
Approved as a Correspondence School Under the Laws of the State of New York

PHOTO ENLARGEMENTS

Size 16x20 inches Same price for full length or bust form, groups, landscapes, pet animals, etc.; or enlargements of any part of group picture. Safe return of your own original photo guaranteed.

98c



SEND NO MONEY Just mail photo or snapshot (any size) and within a week you will receive your beautiful life-like enlargement, size 16x20 in., guaranteed fadeless. Pay postman 98c plus postage—or send $1.00 with order and we pay postage.

Special Free Offer With each enlargement we will send FREE a hand-tinted miniature reproduction of photo sent. Take advantage *now* of this amazing offer and send your photo today.

UNITED PORTRAIT COMPANY
1652 Ogden Ave., Dept. 691 Chicago, Ill.

You—and This New Machine Can Earn $500 a Month

Operate a Tire Repair Shop 90,000,000 Tires in use. America's greatest opportunity for men with small capital. We furnish everything—$100 and up. Easy payments. We train you FREE right at home. Start making money at once. Write today for Free Book of Opportunity.

HAYWOOD TIRE EQUIPMENT CO.
1306 S. Oakley Chicago, Illinois

GIVEN TO YOU

Choose ANY $20 Musical Instrument

Yes, we will give you free a $20.00 quality Violin, Tenor Banjo, Hawaiian Guitar, Banjo, Banjo-Guitar, Cornet, Guitar, Mandolin or Banjo-Mandolin. Learn to play by note. We teach men, women, boys and girls by mail. Amazing new, simplified method. A few cents a day pays for Lessons. Instrument and first lesson sent on FREE TRIAL. Over 500,000 successful pupils. Write today.

CHICAGO CORRESPONDENCE SCHOOL OF MUSIC, INC.
1632 No. Halsted St. Dept. 562 Chicago, Ill.

LAW STUDY AT HOME

Become a lawyer. Legally trained men win high positions and big success in business and public life. Be independent. Greater opportunities now than ever before. Big corporations are headed by men with legal training. Earn

$5,000 to $10,000 Annually

We guide you step by step. You can train at home during spare time. Degree of LL.B. conferred. LaSalle students found among practicing attorneys of every state. We furnish all text material, including fourteen-volume Law Library. Low cost, easy terms. Get our valuable 108-page "Law Guide" and "Evidence" books free. Send for them NOW.

LaSalle Extension University, Dept 383-L Chicago
The World's Largest Business Training Institution

BE A DETECTIVE

Make Secret Investigations

Earn Big Money Work home or travel. Particulars FREE. Write: Dept. P. S.

AMERICAN DETECTIVE SYSTEM
2190 Broadway New York

Name.....

Address.....

DRAWINGS

SPECIAL SERVICE FOR

Inventors and Patent Attorneys to take place of working models made from your sketches or blue prints in pen & ink or shaded photographic drawings - 15 yrs. Exp.

WRITE US YOUR NEEDS

ARMIN A. REINKE STUDIOS OSHKOSH, WIS.

All Metal

(Continued from page 156)

With the great weight gone, the nose came up. Quickly, Jack whirled his automatic stabilizer's adjustment wheel and made the longitudinal correction. Then the *Pacific Gull* sailed blindly into the fifth hour.

"You win, Jack," Cheese said. "Thought she'd konk us!"

During the fifth hour, visibility over the water became better; and it was early in this hour that Jack spotted a ship, a great black liner coming head-on.

"That's a *Maru* boat!" Cheese cheered. Then, a minute later—"And she's the *Tokio Maru*. . . . I know that baby; I've seen her in Frisco a lot."

"Well, that's good and not so good," Jack answered. "If she's headed for San Francisco, then we've been flying for Japan. And if she was three hundred miles out early this morning, she's still farther out than our gas'll stretch."

JACK turned the *Pacific Gull* about, took his direction from the ship's, and started for where San Francisco should be. Then, after a few minutes of flying and thought, he turned back and headed directly for the *Tokio*. Cheese said, "What the h—!"

"Slide in here behind the controls," Jack told him, "and fly in circles above the *Tokio* while I talk to the passengers."

Jack passed a word to the girl and went forward through the companionway. Upon reaching the lady and her three boy friends, he stopped for a moment and assured them that all was better than well. Which was a lie, and Jack knew it.

Upon reaching Mr. Deuss and the four government men, Jack ganged them close together. He pointed out the *Tokio Maru* and talked earnestly.

"These seat booths," he said, "are cork-loaded and self-righting. You might get a little wet, but that's all. It's a cinch I can't carry this load ashore, so, you'll get wet anyway. What do you men say?"

"Listen, pilot," Mr. Deuss said. "You're captain on this ship, and what you say goes. If you say this thing is the only way out—hop to it. Tell my little girl good-by. And I'll meet her in San Francisco."

"And you?" Jack asked the government men.

FOR a few seconds they grinned strange grins and looked from one to the other. Then, as one, they said: "Shoot! You promised to get us to the *Tokio Maru*, and we'll tell the official world you're doing it!"

Thirty seconds later, Jack was back on the controls.

He spoke to Cheese, and at the same time reached to his instrument board and opened a small door behind which were ten short levers. Each lever was numbered. "Go forward," Jack said, "and amuse the lady and her husbands. . . Keep their eyes to the rear. . . Then explain what happens in your own apt way, Cheese."

For a few seconds, Jack studied the drift of the *Tokio's* smoke. After climbing two thousand feet, he flew slightly up-wind from where he had last seen the water craft below the clouds.

In the cabin, Cheese once more checked over the safety belts of the five men who had wanted to reach the *Tokio* in a hurry. Next he moved to a position behind the four rear-seat passengers and attracted their attention by starting an extemporized lecture on the advisability of looking to the rear when flying in clouds. He held their eyes. The five men up front held tightly to their seats.

Jack Page reached out and pulled five small levers. In the cabin, five square sections of floor clicked back

(Continued on page 158)

given! Without extra cost to you. Send coupon for details of our amazing new plan. It tells you how to get a big assortment of beautiful giftwares worth $63.10 when decorated—without a cent of extra cost.

Want Some Money?

Here's a wonderful way to get it

Our beautifully illustrated book tells how. It tells all about our new methods of art decoration, art treatment and how anybody can learn without previous training or experience. It contains page after page of handsome color illustrations of what you can make and sell. You can make good money and this book is FREE. Our system is amazingly easy to learn and the profits are larger than in almost any other business. You can produce beautiful finished art objects almost from the beginning. You don't have to know how to draw or have any experience. Begin making money now. All supplies are sent by us with the instructions and many have made $25 the first week. Some society women have taken up this work for their own amusement. Either way, pleasure or profit, it's the most delightful home work you can imagine. Write now for your copy of this valuable book; it's FREE.

FIRESIDE INDUSTRIES
Dept. 51-C Adrian, Mich.

GOOD FOR PLAN

Now Easy!

Famous Fireside Three-Step Method Shows You how to do

Decorated Furniture
Instruction on handling brushes, color harmony and color schemes, redecoration of old pieces, and all modern finishes.

Wooden Toys
Finishing colorful and original toys for children of all ages.

Copper and Brass Objects of Art
Etching and brush decoration made easy and simple.

Parchment Lamp Shades
Complete instruction in shade making including decoration of parchment with beautiful designs.

Interior Decoration
Simplifying the artistic arrangement of furniture and home glorification.

Gesso and Polychrome
You are shown the art of building up designs in relief to resemble antique carving.

Batiks
The art of textile decoration. Beautiful scarfs, handkerchiefs, dresses, shades and draperies are easily made.

Greeting Cards
A profitable business can be built up in greeting cards alone. We show you how.

ALL GIVEN! With Membership

FIRESIDE INDUSTRIES
DEPT. 51-C. Adrian, Mich.
Tell me how to get the Big Giftware Assortment, the Complete artist outfit, Privilege of Fireside Membership, and your Money making plan on easy basis. This information is FREE.

Name.....
Address.....
City.....State.....

Send for List of Big-Pay Jobs in Photography

Mail this Coupon

Be a Movie Cameraman, a Portrait Photographer or Airplane Photographer. These are just a few of the attractive opportunities open to you.

$50 to $250 a Week

Fascinating Work — No Experience Needed

All kinds of high-salaried positions are open in the most fascinating profession in the world! Find out what Photography offers YOU. Even if you have never used a camera you can quickly qualify for the job you want. Or go into business for yourself. Mail the coupon right now for free Job Chart and illustrated book. Take your pick of the wonderful opportunities as Motion Picture Cameraman, Portrait, Commercial and News Photographer.

Learn at Home or in Our Studios

No need to give up your present employment. You can learn professional photography at home in your spare time. Our exclusive home-study method gives you personal training by experts. CAMERA GIVEN or come to our New York studio for day or evening instruction. Earn while learning.

EMPLOYMENT SERVICE

Our graduates are in constant demand. We help you get positions without charge. Hundreds of others are making big money. YOU can, too. Professional Photography is one of the largest and fastest growing lines of business. More trained photographers are needed quickly.

New York Institute of Photography, Dept. 5, 10 West 33rd St., New York City.
Yes! Send me the FREE Job Chart and illustrated book of money making opportunities.

Name.....
Address.....
City.....
State.....

Wonderful New Book

FREE

Read all about today's opportunities. Read what others are doing. The facts about photography will open your eyes. Mail the coupon NOW for handsome, big book, fully illustrated—it's FREE.

New York Institute of Photography, Dept. 5, 10 West 33rd Street New York City

Now

A 2¢ STAMP

Puts You on the road to

9 BIG PAY JOBS

See how amazingly easy it is now to take your choice of the 9 biggest jobs in the building game! Men who can read blue prints are at a premium everywhere in this six billion dollar field. And now, right at home, in a surprisingly short time you get the same blue print training that has shown thousands the way to . . .

$4,500 TO $12,000 A YEAR

NO LONGER need any man spend years learning all the "mysteries" of blue print plan reading. For now you can get the blue print training in a few months that it has taken others years to pick up "on the job." This is the training that leads to all the 9 big pay jobs in building or a profitable contracting business of your own.

This is no ordinary school course. It is all practical. You get many full sets of real architects' working blue prints to examine and keep for reference. Twenty practical building experts then go over these blue prints with you, step by step. Explain everything. Talk to you in clear, plain language as easy to understand as your newspaper. There is no grinding study. No textbooks to wade through. The whole course is just like playing some fascinating new game.

See what this training has done for others. After finishing it, Baker, Ohio, made $3,800 clear profit in 3 months as a contractor. Depke, R. I., increased his salary 700% in 12 months. Clifford Scholl, a laborer, became ass't superintendent in 8 months. Marchand, La., writes, "My salary is now increased 196%."

FREE BOOK

This training will do the same for you. Want proof? Then don't send one penny, just mail the coupon below. It will bring a complete set of real prize-winning blue prints, and the remarkable book "How To Read Blue Prints," all absolutely FREE. It will also bring complete details of the 9 best jobs open in America today for men with practical blue print training. So don't delay. Mail the coupon right now.

Chicago Technical School for Builders

Dept. C-151, Chicago Technical Building
118 E. 26th St., Chicago, Ill.

Chicago Technical School for Builders,
Dept. C-151, Chicago Technical Building,
118 E. 26th Street, Chicago, Ill.

Send me your free blue prints and free book. It is understood these are mine to keep without cost or obligation. It is also understood that no salesman will call on me.

Name.....

Address.....

Town.....State.....

All Metal

(*Continued from page 157*)

into place, and the remaining four aerial wanderers wondered at the great empty space where, seconds before, five noisy men had sat and talked.

"Where are they?" the lady demanded of Cheese. And she pointed at where *they* weren't. Her three men echoed the question:

"Where are they?"

"Ah," Cheese smiled. "That is the question! . . . They've gone down to the lower deck for a smoke."

"I didn't know that there was a lower deck," the lady exclaimed.

"It's a big ship," Cheese answered. He went through the companionway. And said—"Yes, the *Tokio Maru* has many decks."

"One . . . two . . . three . . . four . . . five," Cheese counted as he gazed down over the cockpit's gunwale. "They all got away, Jack, and with clean openers."

"Parachutes!" the girl discovered. "Where did they come from and who are they?"

"The nearest one to our tail," Jack told her, "is your dad. The other four are carrying the government boys. They're going down to the *Tokio Maru*. That comes of being in a hurry."

"But me," the girl cried—"why was I slighted? I have always wanted to ride a parachute."

"ME TOO," Jack laughed, "but it's a thing that can wait. I released those parachutes when I sprung these levers," he explained.

"But the parachutes," the girl asked, "where were they?"

"The parachute to each seat is packed away under the central walk. When the booth drops through the trap door, it drags its attached parachute out for a positive opening. The idea is Cheese's. Also, Cheese had the idea that laymen must be 'dumped.'"

Circling down, Jack brought the *Pacific Gull* up over the *Tokio's* stern. Already the parachutes had been sighted and the big liner—judging by the white foam along her sides—had reversed her screws and was standing by. On the boat deck there was much activity; soon something was on its way down from the davits. The Japs were prepared to pick up the jettisoned five.

REMEMBERING his own troubles, Jack Page again judged his line of flight from the *Tokio's* bow and hi-tailed into the east. Looking back, just before the clouds once more blotted out the scene, Cheese cheered: "Some shooting, Jack—some sharpshooting, I'll say! You put Mr. Deuss right into the *Tokio's* rigging! . . . There's another, right in near her bow. . . . The third down midships. . . . And the other two a few hundred feet astern."

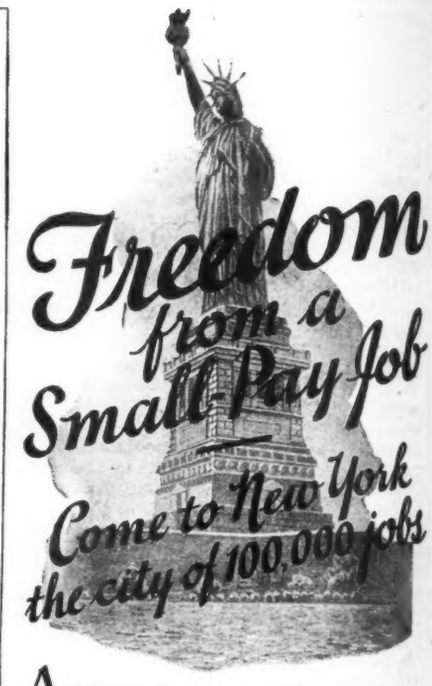
"I should have dumped the others," Jack now decided. "The whole thing went off so smoothly. But I knew they'd yell blue murder if I told them what to expect. We'll have a chance now, though. If we can't make land, the *Tokio* will be along to pick us up; that is, if our flotation chambers work as they should. . . . And it won't be long now, because our gas is just about out."

"Maybe you're closer in than you think," Cheese suggested. "And perhaps we'll make it yet."

"Maybe," Jack mused, "is a good aeronautical word. But *maybe gasoline* never kept any plane on the wing. *If* we do it, Cheese, it will be God-sent, and I don't mean maybe."

"Another ship!" the girl shouted. She pointed dead ahead. Out front, a few miles, a small thing was plying its way shoreward.

When they could ascertain its color, Cheese placed the brownish-red craft as a Matson boat. "The (*Continued on page 159*)



ANY MAN who can read and write and use a pair of pliers can become an electrical expert and free himself forever from the long hours and drudgery of a small pay job.

And you can learn the BIG PAY profession of electricity right in New York City—the heart of the electrical world—the city of 100,000 jobs. At the same time you are learning the BIG PAY profession you can be enjoying the sights and wonders of New York, the modern Bagdad.

Be an Electrical Expert

Graduates of the **NEW YORK ELECTRICAL SCHOOL** are in demand by all the big electrical companies. Or, if you prefer the independence of a business of your own, there are thousands of opportunities for efficient, **dependable** men to become electrical contractors. When you are your own boss the money you can make is limited only by your own energy and ability.

Personal Instruction

The **NEW YORK ELECTRICAL SCHOOL is not** a correspondence school. You learn by doing—by personal instruction on full size standard electrical equipment under the personal supervision of trained instructors.

At N. Y. E. S. you train your hands and mind at the same time. You learn the theories of electricity—and then you are shown how to put the theories into actual practice by solving the problems with **your own hands.**

The man who has learned electricity by actually doing electrical work under intelligent personal instructors can go to any part of the world and be sure of a good living. There are N. Y. E. S. Graduates in all the countries of the world.

Write today for the 48-page booklet giving full information about the N. Y. E. S. Course and showing pictures of the equipment available for your personal use in our two seven-story buildings.

The NEW YORK ELECTRICAL SCHOOL

40 W. 17th Street, New York

MAIL TODAY

THE NEW YORK ELECTRICAL SCHOOL
40 W. 17th Street, New York.

Please send me **FREE** your 48-page booklet. It is understood that this request puts me under no obligation.

Name.....

Address.....

.....

All Metal

(*Continued from page 158*)

Hilo," he decided. "That's the boat that our lady friend and her three yes-men want to make."

"Cheese," Jack said, "go forward and take a look at four safety belts. I promised her I'd get them to the *Hilo* in time, and I'm as good as my word." Quickly, the willing Cheese was gone.

"And what about little me?" the girl asked. "Do I go bye-bye this time?"

"Not so's you'd notice it!" was Jack's backwash. "Nix!"

"Everything's set"—Cheese came to the passage and reported—"and all four are still looking up. . . . Want me to show them the way down, Jack?" As he spoke, he was making ready.

"Want to go, Cheese?" The question was foolish.

"Every pound counts, Jack; and I'm no lightweight. What's more, you have no real use for me. . . . I'll go down and have the *Hilo* wireless the Coast Guard to be on the lookout for you."

"SO-LONG, Cheese,"—they shook hands—"and have the *Hilo* on the lookout, too. . . . Get into that seat. We'll be up wind from the boat in a shake. Step on it!"

Seconds later, they were abreast of the steamship. Jack made a few brief remarks to the girl at his side and pulled five more small levers. With her head hanging from the cockpit—"One . . . two . . . three . . . four . . . five," the girl counted. "They've all opened."

Back over the *Pacific Gull's* tail surfaces, Miss Deuss continued to watch. "They're lowering a boat . . . Two are down just behind the ship . . . A third just ahead . . . The other two behind, so close I can't see them . . . Good shooting! Fine sharpshooting, I'll say, Jack Page!"

"Oh, boy!" Jack grinned. "I'd sooner be up here than down there in Cheese's boots when that old girl is fished out."

"You and me both!" the girl smiled. "Think they're still looking up? Or do you suppose they've caught seasickness from too much free air?"

"They wanted the *Hilo* in the worst way," Jack grinned, "and they got it."

"In the worst way," she added.

FOR a while the *Pacific Gull* droned shoreward. Jack studied his instrument-board telltale glasses.

"I don't know what she's flying on now," he mused; "because, according to the glasses, all the gas is gone. . . . It's ten after four. And still she carries on. All metal, my ship is! And her motors and spirit, too."

"To say nothing of her pilot," the girl added. There was a long silence.

"I have one more card to play," Jack said at last. "If the *Gull* is all that she should be, she'll cruise on one motor. . . . If she won't—then you and I must get set for a wetting."

"If you built her that way," said the girl, "then she'll do it."

Jack cut the switch of his right motor, the wing fell a little till he "picked it up" with left-rudder, then the *Pacific Gull,* at reduced speed, cruised on. "That will save half of what gas is left—if any," he said. "Miss Deuss, hold the lobe of your left ear and wish. . . .

"Look!—the shore line!" Jack pointed. The clouds to the east were on the blow. Now and then they lifted. And, here and there, the mainland came into view; it was perhaps twenty miles away. "Now is the time, *Pacific Gull,*" Jack exhorted, "to prove that you are with me, and believe me, *Gull,* you're a gone gosling if you don't do your stuff now!"

Silently, tensely, Jack watched the direction of wind-ripple

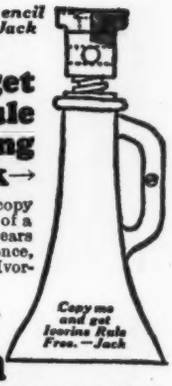
(*Continued on page 160*)

FREE

This Genuine Ivorine Pocket Rule

Get out your pencil and copy the Jack right now

←You get this rule for copying this Jack→



Copy me and get Ivorine Rule Free.—Jack

Can you copy it? Try it. How you copy it may give me some idea of what kind of a draftsman you would be. If you are 16 years old or older and will mail me your sketch at once, I will send you, free, and prepaid, a draftsman's Ivorine Pocket rule, shown here.

This will go to you entirely with my compliments.

In addition I will send you my book on Successful Draftsmanship. Don't wait. Copy the sketch now and mail it to me.

Draftsmen Needed In

Auto Work
The automobile industry is one of the greatest in America. Thousands of draftsmen needed. I'll train you for the work.

Electricity
Electricity is the coming motive force of the world. Draftsmen are needed in every department of this fascinating work. I'll train you at home. Get a job here.

Aviation
Aviation is just in its infancy. It is bound to expand to enormous proportions. Draftsmen are essential to it. I'll train you quick at home for drafting position.

Motor Bus Work
Motor bus building and motor bus transportation have become leading world industries. Hundreds of draftsmen engaged in this work. I'll show you the way.

Building Work
There will always be building. No structure can be erected without plans drawn by draftsmen. I'll make you an architectural draftsman at home.

Get My Free Pay-Raising Plan

Write to me. I will send you this new book. Not a catalog. My Pay-Raising Plan and Money-Making Advice. I can prove that John Savadge, trained by me, makes $300 a month. Earl J. Dupree, trained by me, refused $600 a month because he makes more in his own business. A. H. Bernier, trained by me, earns $7000 to $9000 a year. Arthur Dewalt, trained by me, makes more than $400 a month. D. C. Stroop, trained by me, makes $475 a month. L. V. Broughten, trained by me, makes $300 a month.

I can give you many more names of Dobe trained draftsmen who are making big salaries. They wrote to me just as I am asking you to write. They asked for my Free Book. They saw that opportunities in all of the great industries were tremendous for draftsmen. Through drafting you can get into almost any industry you want

Money Back If Not Satisfied
What could be fairer than that? I don't ask you to take any chances. I train you under a positive Money Back Agreement. If my training does not satisfy you after you have finished you get every penny back.

Earn While You Learn
You can start earning extra money a few weeks after beginning my training. I give you special work and tell you how to make money.

Age or Lack of Education No Drawback
You do not need previous experience. You do not need to be a high school graduate. My practical home study course gives you just the kind of training you need to become successful. Your spare time is all that is necessary.

Employment Service
After training you I help you to get a job without charging you a cent for this service. Employers of draftsmen come to me for men because they know that men I train make good.

I Train You at Home, Now, Quick, Sure Way
My practical working method makes every step in learning drafting, as clear as a moving picture. That's why I train you so fast to be a draftsman.

You get these tools as my student

You GET THESE FINE QUALITY, GENUINE, IMPORTED DRAFTSMAN'S TOOLS, just as soon as you become my student. No finer tools can be made for practical drafting work.

"I will train you at home."—Engineer Dobe

If You Earn Less Than $70 a Week Write Me Today!

ACT NOW Before You Put This Magazine Down. Let me send you my books "Successful Draftsmanship" and "My Pay-Raising Plan." Remember Draftsmen are needed everywhere. That's the kind of profession to get into. Get started now. Get into a better position, paying a good straight salary the year around.

Engineer Dobe 1951 Lawrence Avenue Div. 13-63, Chicago, Ill.

FREE RULE COUPON!

ENGINEER DOBE
1951 Lawrence Ave., Div. 13-63, Chicago

Here's the sketch. Send me free rule; also send me free of all cost, books "Successful Draftsmanship" and "My Pay-Raising Plan"—how to earn money while learning and proof of big money paying positions.

Name..... Age.....

Address.....

Post Office..... State.....

YMCA TRADE SCHOOL

Learn Auto Mechanic, Auto Electrical, Battery, Machine, Electrical, Radio Mechanic, Tiling, Bricklaying, Plastering, Plumbing, Welding, Drawing, Estimating, Show Card, Sign Painting Window Dressing, Fine And Commercial Art. Write for Catalog 50.

BROOKLYN ENGINEERING INSTITUTE (Operated by Bedford Br. Y. M. C. A.) 1125 Bedford Ave., Brooklyn, New York City.

ALL-IN-ONE
Cigarette and Match Case

50c ALL-IN-ONE holds a package of cigarettes and a box of safety matches, always handy — ready for use. Beautiful grain finish Black or Brown Du Pont Fabricoid. Keen and convenient. This is easily a dollar value we are offering you by mail for 50c. All-in-One will come to you prepaid. A dollar bill brings two cases. **Agents Write.**

PATENTED

ALL-IN-ONE SALES COMPANY
2810 Portland Ave. Dept. 13 Minneapolis, Minn.

ADDING MACHINE VEST POCKET SIZE

ADDS, SUBTRACTS, MULTIPLIES, DIVIDES

Does work of a $300 machine. Guaranteed 5 years. NOT A TOY. Made of steel and indestructible. Million dollar capacity. Fits in pocket. Will not make mistakes. So simple child can operate it. Everybody should carry one for figuring.

FREE TRIAL SEND NO MONEY

---Just name and address. We will ship Calculator immediately. On delivery pay postman $2.50 (Plus few cents Postage) 10c additional for Handsome Leatherette Case. (If outside U. S. send cash.) If not satisfied after 10-day trial you get your money back. THOUSANDS OF SATISFIED USERS. This is lowest priced practical calculator made. Why pay more for inferior imitations?" Order from this ad.

$2.50 TOTAL COST

Mail Coupon Today

BABY CALCULATOR SALES COMPANY,
Dept. 61, P. O. Box 1118, CHICAGO, ILL., U. S. A.

[ ] I am enclosing $2.50—send adding machine prepaid.
[ ] Send adding machine C. O. D. $2.50 plus postage.

Name.....
Address.....
City..... State.....

AGENTS Write for big commission and exclusive territory proposition.

A definite program for getting ahead financially will be found on page four of this issue.

you can quickly Learn Electricity

By Mac's Improved Practical Shop Methods

In just a few short weeks, I'll make you a practical trained electrician. My course includes everything you need—motor repairs, armature winding, sub-station work, installation, maintenance, battery work, house-wiring, telephony, telegraphy and general electrical training in both alternating and direct current. You not only learn the work, but you actually DO it. You work with real tools and real equipment. Mac's Shop plan makes the big-pay man.

No Books—No Printed Lessons

At McSweeny Schools, you learn BY DOING—the only practical way. No books—no printed lessons—no dry lectures. You work right under the eye of an instructor who tells you, shows you, helps you. You have confidence in yourself when you finish the McSweeny course, for you know you KNOW. Come with me now. Fit yourself for a big job. Get out of the old rut. Don't go begging for a job or put up with small pay. Learn electricity and the JOBS will look for YOU.

Earn $50 to $125 a Week

The minute you enter a McSweeny School you start on the road to big pay, independence, a real future. When you have finished the course, which takes only a few short weeks, I'll help you get located, my employment department will give you lifetime service. I stand right back of every McSweeny-trained man and do everything within reason, in and out of school, to make him a big success.
Get started now. Take the first step. Write at once for my amazing winter tuition offer which includes

Board and R. R. Fare

I mean it. I'll include your railroad fare to either school and pay your board while learning. Tuition and everything is included in my remarkable offer. No books to buy—no extras to pay for. Get my amazing offer at once. You'll be surprised how little the cost is.

Mail Coupon for Big Electrical Book FREE

Tells you all about the famous McSweeny Schools and the big opportunity for trained electricians. Read this book. It will help you. It's yours FREE just for mailing the coupon.

McSWEENY
ELECTRICAL SCHOOLS
Dept. 52-C1
Cincinnati, Ohio Cleveland, Ohio

McSweeny Electrical Schools,
Dept. 52-C1 Cincinnati, Cleveland.
(Address nearest School)

Without obligation, send me your big free book and remarkable tuition offer including R. R. fare and board.

Name.....

Address.....

Town.....State.....

All Metal

(*Continued from page 159*)

on the water below; it showed that he was being favored with a tail-wind—a breeze from his rear which would help carry the *Pacific Gull* through these last few tight miles. "Everything's coming our way," he said; and told the girl of his latest good luck. "It's like the drowning man and his straw, Miss Deu—"

"First name—Almira—Al for short," the girl told him.

"Well, Al—we're like the drowning man: we'll reach for anything now."

"Well, reach for that shore, Jack, and reach hard," Almira—Al Deuss urged. "But if you don't reach, Jack. . . . My! what a man-sized try you've made!" Her voice, like all else, seemed slow.

In the ages that followed, there were slow miles for the hard-put *Pacific Gull*. At last, with only a few more miles to go, the single motor konked, flatly, and almost quit. Quickly, Jack dropped the left wing lower—to drain all possible gasoline toward the dying power plant—and, with a new bark, the engine came to life. In the gas-lines, perhaps, a few pints remained.

"THIS is what I call being hard-up," Jack told Almira, "and if you could handle the controls, I'd go forward and squeeze the gas tanks for a few more drops." His eyes never quit the nearing shore, and he added—"M'gosh, girl, this is the time and place for the augmented orchestra to strike up 'California, Here I Come'; and they'd better bear down heavily on—'Just Open Up That Golden Gate'."

A flock of shore-scavenging gulls were taking their evening knock-off from work on the beach sands of San Francisco's long Pacific waterfront. All attention, they watched and wondered at something that came a-fluttering toward them across the wave crests. Then, with a wild scurry, they took wing and quit the sands to make room for a real gull. The *Pacific Gull* came a-rushing!

For the last few hundred yards, Jack Page came in on his ship's glide. The lone motor had gurgled and gone out of business for keeps. But gliding momentum, plus her flotation chambers, plus the aqua-dynamic force that carries a surf-board atop the crest, all joined in rolling the great, spent *Gull* high and dry upon that deserted strand.

The Coast Guard crew came running. At first the guards thought there was only one person in that aft cockpit. Coming closer, they learned that two can sit as close as one—and in the same control seat.

HOURS later the *Hilo* made port. At about the same time, the *Tokio Maru* nosed into her berth. And, among the 'chute-delivered ten, there were no soreheads. Even the potent lady with three men was not displeased with the adventure. "Thrilling!" she avowed. "In all my life, no trip like that!" But her husband, it seemed, had caught a cold from his immersion. "His own fault!" the lady told everybody aboard the *Hilo*. "When we came to California—two weeks ago—I warned Horace against removing his flannels. But he would be a sport, and now look at him!"

Cheese was sore, too. He had undertaken to teach a number of the *Tokio's* brown boys one of our foremost national games. The session on knees came off in the forecastle; and the little brown cousins had taught Cheese a few things that he had never before dreamed of.

Not many days passed before Cheese, in a San Francisco hangar, had a gang busy with the rehabilitation of the all metal *Gull*. Early one morning, Jack Page came in to tell them to take their time.

"Do this job right," he said. "There's no rush now. When I get (*Continued on page 161*)

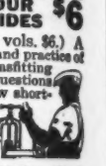
HELP

IN A HANDY FORM
$1 A MONTH

Expert Help and Inside Information for Builders! Up-to-date, complete Trade Guides and Trade References—handy, pocket size; fully illustrated; easy to learn. Don't trail behind! Be a boss! Study in spare time. Send for Guides covering your trade, on free trial. Pay $1 a month if satisfied. Mail Trial Coupon Today!

CARPENTERS FOUR GUIDES $6

Audels Carpenters Guides. (4 vols. $6.) Explains how to handle every kind of carpentry job—inside or outside work. Pictures, plans, calculations and diagrams make any job easy. New short-cuts, modern methods explained. Builders and contractors questions answered. Steel Square and other problems solved. A practical Guide and helping hand for every carpenter; easy, quick methods of work that help you to be a leader.

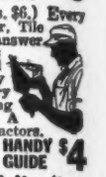


PLUMBERS FOUR GUIDES $6

Audels Plumbers Guides. (4 vols. $6.) A standard Guide explaining the theory and practice of all plumbing, heating, steamfitting, gasfitting and sheet metal work. Answers your questions on any job. Clearly explains the new short-cuts and modern methods so you can understand. A complete reference of the Trade and home study course. Fully illustrated, authentic, up-to-date, with complete Plumbers' Code.

MASONS FOUR GUIDES $6

Audels Masons Guides. (4 vols. $6.) Every Bricklayer, Cement Worker, Plasterer, Tile Setter and Stone Mason will find the answer to his questions and problems in this series. Inside Trade information on all the latest and best practice. A Study Course and complete reference library covering the Mason's Trade; including practical outline of steel construction. A helping hand for workmen and contractors.



ELECTRICITY HANDY GUIDE $4

Audels Handy Book of Electricity. (1 vol. $4.) A reliable authority and handy helper for every Electrical Worker, covering Wiring, Radio, Calculations, Armatures, Maintenance, Motors, Batteries. A complete Study Course and Ready Reference in one handy Guide for Electrician, Engineer and Student.

THEO. AUDEL & CO. 65 W. 23 ST. New York City

TRIAL COUPON

Please mail me for *free examination* the books marked (x) below. If I find books satisfactory, I will mail $1 in 7 days on each set ordered and will mail $1 a month on each set ordered until I have paid purchase price.

☐ CARPENTERS FOUR GUIDES $6
☐ MASONS FOUR GUIDES $6
☐ PLUMBERS FOUR GUIDES $6
☐ ELECTRICIANS HANDY GUIDE $4

Name .....
Address .....
Occupation .....
Employed by 3T34

$1900 to $2700 a year

Long vacations with pay. Work easy. Travel on fast trains with all expenses paid, including hotel. No worries about the future.

MY FREE BOOK TELLS HOW

Get my big free book about the Civil Service which tells all about the Railway Postal Service, and other positions, and how I can help you. Write today.

PATTERSON SCHOOL
Arthur R. Patterson, Civil Service Expert
163 Wisner Bldg. Rochester, N. Y.

"STAMMERING
Its Cause and Cure"

You can be quickly cured if you stammer. Send 10 cents, coin or stamps, for 288-page cloth bound book on Stammering and Stuttering. It tells how I cured myself after Stammering and Stuttering for 20 years.

BENJAMIN N. BOGUE
11851 Bogue Bldg., 1147 N. Ill. St. Indianapolis

All Metal

(*Continued from page 160*)

back we'll hit the ball and start all over."

Then he said good-bye to the gang. Jack was on his way to England and the Continent; bent on the study of foreign airways . . . and other things.

"He sure has the flash of a tin god!" one of the mechanics remarked when Jack had gone. "Some brassy bird! Imagine this cloud-buster walking off with Big-Man Deuss' youngest kid."

"And making the old man like it!" another wailed. "Old Deuss and all his jack! . . . My gosh! what a cast-iron crust this steely guy has, and with all the high mucky-mucks in the Southwest trying to capture Almira."

"Tin god! . . . Brassy bird! . . . Cast-iron and steely!" Cheese Farling came out of a cockpit feet first to exclaim. "Well, I'll say you guys is right—all you say, all metal is what Jack Page is, brothers; all metal!"

Why We Are Immune to Some Diseases

(*Continued from page 22*)

exercised rats were ill, and five of them died.

Ten guinea pigs were well fed, ten put on reduced diet and ten actually starved. All were then infected with pneumonia. The starved pigs were given all they could eat and only two died. The well-fed group got all they could eat and five died. But the reduced-diet group got no food after the infection, and seven died.

"All of which seems to show," concluded Dr. Spaeth, "you may be safer against infectious diseases at those times when you are putting on weight than when you are in the pink of condition after a period of training or exercise."

Antibodies are of two kinds—those that attack the bacteria themselves, and those that attack the toxins, or poisons, produced by the bacteria. The latter antibodies are called antitoxins. The former are divided into three groups—some kill the bacteria by dissolving them, others "clump" them and still others simply "eat" them. These are called, respectively, lysins, agglutinins and opsonins.

THE Schick test for diphtheria immunity is probably the best known. A tiny amount of diphtheria toxin is injected under the skin. If a red, inflamed area appears, you are susceptible—your blood contains no antitoxin (antibodies) to neutralize the poison. If you are immune, no mark at all appears on your skin—the antitoxin within you has immediately neutralized the injected toxin.

Dr. Famulener endorses four rules to protect yourself against contagious diseases:

1. Find out by test what diseases you are immune to. Your doctor can test your immunity to diphtheria, smallpox and scarlet fever. If you have ever had typhoid, cholera, smallpox, chicken pox, scarlet fever, measles and mumps, you are probably immune to these.

2. Immunize yourself, by vaccination or inoculation, against diseases you are not immune to. A list of the sicknesses for which successful immunization has been found has already been given in this article.

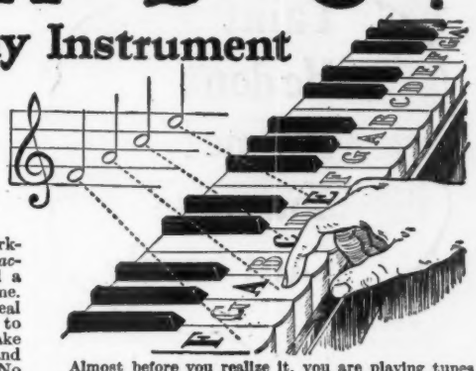
3. Avoid channels of infection, as directed by local boards of health in times of incipient epidemics.

4. Observe general hygienic rules, particularly in regard to cleanliness, sunlight and fresh air.

And you can't do much else against germs than follow these rules, the doctors warn. You can't escape them. Between 1400 and 15,000 microbes enter your nostrils in one hour's tranquil breathing. The only thing to do is to forget them, and hope that the fighting chemists and bacteriologists some day will perfect methods of immunizing against all infectious diseases.

Easy as A-B-C !

You Can Play Any Instrument In a Few Months This Delightful New Easy Way!



ANY one can easily learn music by this remarkable new method. And the cost is only a *fraction* of the old slow way. You don't need a private teacher. You study entirely at home. Almost before you realize it you are playing real tunes and melodies, both popular and classic, to please your friends, amuse yourself, and make money. This wonderful new method of reading and playing music is as simple as reading a book. No private teacher could make it any clearer. The lessons come to you by mail at regular intervals—complete printed instructions, diagrams, all the music you need. You can select your own time to study or practice. And the cost averages only a few cents a lesson, including the music. If you play, you are always in demand. Many invitations come to you. And you meet the kind of people you have always wanted to know.

Learn to Play by Note

Mandolin	Saxophone
Piano	'Cello
Organ	Ukulele
Violin	Cornet
Banjo	Trombone

or any other Instrument

You Play from Notes

The famous U. S. School of Music course is based on sound, fundamental musical principles, highly simplified. No "trick" or stunt method. You learn to play from notes, just as the best musicians do. You learn to pick up any piece of music, read it, and understand it! So easily—so pleasantly!

Almost before you realize it, you are playing tunes and melodies on your favorite instrument. You'll be astonished at your own quick progress. Many students get ahead twice, and even three times, as fast as they would the ordinary routine way.

Free Book Tells All

Our free booklet, "Music Lessons in Your Own Home"—contains an offer that makes the course available at a very low price. Also a Demonstration Lesson which shows how delightfully quick and easy the wonderfully simple Method is. Instruments supplied when needed, cash or credit. If you really want to become a good player on your favorite instrument, mail the coupon now—to-day. U. S. SCHOOL OF MUSIC, 83 Brunswick Bldg., New York.

U. S. SCHOOL OF MUSIC,
83 Brunswick Bldg., New York City.

Please send me your free booklet, "Music Lessons in Your Own Home," with introduction by Dr. Frank Crane, Demonstration Lesson, and particulars of your offer. I am interested in the following course:

..... Have You Inst? .....

Name.....

Address.....

City..... State...

you can earn $50-$100 weekly

New plan makes it easy. We start you in business and help you succeed. Sell Madison "Better-Made" Shirts for large manufacturer direct to wearer. Spare or full time. No capital or experience needed.

Write for Free Samples

Madison Shirt Mnfrs., 562 Broadway, New York

Electricity at your finger ends

Know the facts in Electricity. They mean more money and better position for you. Hawkins Guides tell you all you need to know about Electricity.

Every important electrical subject covered so you can understand it. Easy to study and apply. A complete, practical working course, in 10 volumes.

Books are pocket size; flexible covers. Order a set to-day to look over.

HAWKINS GUIDES

3500 PAGES **$1 A VOLUME**
4700 PICTURES **$1 A MONTH**

These books tell you all about—

Magnetism—Induction—Experiments—Dynamos—Electric Machinery—Motors—Armatures—Armature Windings—Installing of Dynamos—Electrical Instrument Testing—Practical Management of Dynamos and Motors—Distribution Systems-Wiring-Wiring Diagrams—Sign Flashers—Storage Batteries—Principles of Alternating Currents and Alternators—Alternating Current Motors—Transformers—Converters—Rectifiers—Alternating Current Systems—Circuit Breakers—Measuring Instruments—Switch Boards—Wiring—Power Stations—Installing—Telephone—Telegraph—Wireless—Bells—Lighting—Railways. Also many Modern Practical Applications of Electricity and Ready Reference Index.

SHIPPED TO YOU FREE

Not a cent to pay until you see the books. No obligation to buy unless you are satisfied. Send Coupon now—today—and get this great help library and see if it is not worth $100 to you—pay $1.00 a month for ten months or return it.

SEND NO MONEY

THEO. AUDEL & CO.
65 W. 23rd St., N. Y.

Please submit for examination Hawkins Electrical Guides (Price $1 each). Ship at once, prepaid, the 10 numbers. If satisfactory I will agree to send you $1 within seven days and to further mail you $1 each month until paid.

Name .....

Address .....

Occupation .....

Employed by 3T34

BE A RAILWAY TRAFFIC INSPECTOR

Earn Up to $250 Per Month SALARY and Expenses

NO HUNTING FOR A POSITION AFTER COMPLETING YOUR TRAINING

Read what Dan'l M. Mack says:

"I received my certificate on April 15, was on my way to take a position on the evening of April 16, and started to work on April 17. If this is not quick work, I don't know what it is. I found the school very thorough."

Our students never worry about a position as one will be secured within a few days after completing the Traffic Inspection course. You start at $120 or more per month plus expenses, and advance rapidly to $150, $165, $180 and up. Our contract shows why you take no risk.

As a Railway Traffic Inspector, you are practically your own boss, see new faces and places each minute, report only to high officials, are rapidly advanced. It's healthful outdoor work with regular hours.

Hundreds of Satisfied Graduates

During the last nine years, hundreds of our graduates have found satisfaction and increased incomes in Traffic Inspection. They took no chance—started on a definite salary. You can do the same. Write today for our free booklet, and contract agreeing to assist you to a position after graduation or refund your money.

Standard Business Training Institute, Div. 3, Buffalo, N. Y.

Send me your free Booklet giving full particulars about Course in Traffic Inspection.

Name.....

Address .....

What Are YOUR Mistakes in English?

They may offend others as much as these offend you

IF some one you met for the first time made the mistakes in English shown above, what would you think of him? Would he inspire your respect? Would you be inclined to make a friend of him? Would you care to introduce him to others as a close friend of yours?

These errors are easy for you to see. Perhaps, however, you make other mistakes which offend other people as much as these would offend you. How do you know that you do not mispronounce certain words; are you always sure that the things you say and write are grammatically correct? To *you* they may seem correct, but others may know they are wrong.

Unfortunately, people will not correct you when you make mistakes; all they do is to make a mental reservation about you. "He is ignorant and uncultured," they think. So you really have no way of telling when your English offends others.

FREE Book on English

Sherwin Cody, perhaps the best known teacher of practical English, has perfected and patented a remarkable device which will quickly find and correct mistakes you unconsciously make. Correct English soon becomes a HABIT.

If you are efficient in English, it will give you greater confidence; if you are deficient, you surely want to know it, so that you can correct your mistakes.

Mr. Cody's remarkable new invention, the 100% Self-Correcting Method, has already improved the English of more than 50,000 people. No useless rules, no tedious copying, no hard study. Only 15 minutes a day required. You learn by creating the HABIT of using correct English. Nothing like Mr. Cody's method has ever been used before!

A new book, "How to Speak and Write Masterly English," is ready. It explains Mr. Cody's surprisingly easy method. Get a copy free and learn how to stop making embarrassing errors. You do not want others to judge you unfairly. Merely mail the coupon or a postal card. SHERWIN CODY SCHOOL OF ENGLISH, 183 Searle Building, Rochester, N. Y.

Sherwin Cody School of English
183 Searle Building, Rochester, N. Y.

Please send me your Free Book, "How to Speak and Write Masterly English."

Name .....

Address .....

.....

Sperry—Competitor of the Sun

(*Continued from page 27*)

enough to let the flywheel rotate inside the ring without touching it. And this circular rim was itself held in bearings in a "Y." But the bearings of the ring were a quarter of a circle or ninety degrees around the ring from the bearings of the flywheel.

"This is a gyroscope, and except for size and driving power behind it, it isn't any different from the gyroscopes which are used in navigation," he said. "A gyroscope is simply a flywheel so mounted that it is free to rotate in any direction, instead of one direction only."

He wound a string around the axle of the flywheel and gave it a smart pull, and the little wheel spun like a top. "Try to turn it over by pushing against the rim," he said. I was surprised at the resistance offered by the tiny mechanism. I turned the "Y" standard around and the spinning wheel flopped over, end for end.

"THE principle underlying the gyroscope and its applications is that every rotating body tends to revolve in a fixed plane in space and resists every effort to change its plane of rotation," he explained.

"The plane in which the gyro rotates is a plane in space, which has no relation whatever to the earth itself. It will keep rotating in that plane, if permitted, regardless of the movement of the earth beneath it. Put it afloat, as in a ship, and it will always know where the center or axis of the earth lies with reference to itself.

"It occurred to me that if a mariner could always tell the exact direction from his ship of the axis of the earth, he could tell in what direction he was heading. The gyrocompass points always to the true North.

"The gyrosteering device and the gyrostabilizer utilize the gyroscope's resistance to change. 'Metal Mike,' as the gyro helmsman is called, steers by the gyrocompass, which tells him the course. Every wave, current or puff of wind which diverts the ship's head from the true course gives 'Metal Mike' a shove, and he shoves back, just as a human quartermaster would. But he is much more sensitive to the least variation from the compass course and his response is quicker.

"The gyrostabilizer is sensitive to the first impulse of the first wave, and gets into action instantly, steadying the ship before the second wave has a chance to get in its cumulative effect. Thus it takes only weight and force enough to counteract the effect of one wave to keep the craft on an even keel."

A Japanese cruiser of 16,000 tons, taken out in a heavy sea for a test, rolled twenty degrees each way without the gyrostabilizer and less than two with it.

THE plans now under way for a fleet of enormous passenger ships to run between England and America in four days flat call for their equipment with gyrostabilizers, Sperry told me.

The first application of the stabilizer to airplanes was perfected in 1913. Sperry and his son Lawrence—later lost flying the English Channel—equipped a Curtiss plane with a gyroscope and sent it to the Aerial Security contest in France in 1914. The plane was flown with no other control, and a man walked out to the end of one wing without deflecting it. This "automatic pilot," as the French called it, won the grand prize. Out of it developed the idea of the aerial torpedo, which is simply a pilotless airplane, carrying a load of high explosives, directed toward its distant target under the guidance of a gyroscope. Seven of these, built during the war, hit targets thirty-five miles distant in tests. The Armistice came just as production in quantity for use at the front was beginning.

"When did you first think of entering into competition with the sun, Mr. Sperry?"

"Now you are going back a long way," he smiled. "Back to the very beginning of my career. And that started in Chicago, in 1880, October 12th—my twentieth birthday. That was the day when the Sperry Manufacturing Company turned out its first electric dynamo, and its first arc lamp."

I drew out enough of the story of his boyhood to account for the man facing me now. A Yankee boy from the oldest New England stock, motherless, brought up by his grandparents in Cortland, N. Y. "A nuisance to the neighbors, I'm afraid," he laughed, "making toy windmills, pestering the men in the sawmill and the machine shop until they let me use their tools. I blew up one boy with an experiment with benzine vapors, but fortunately he was not badly hurt. Another time I set a neighbor's back porch on fire."

HE WENT to Cornell University for one year of physics and engineering and decided how to make an electric generator twice as efficient as Gramme's dynamo which supplied the current for Brush's electric arc light, one of the marvels displayed at the Philadelphia Centennial of 1876. Local business men put up the money and before he was nineteen, people were flocking to see his miracle.

Chicago was the place for a young man, the boy decided soon, and there he went. He built a tower—the highest in the world, three hundred and fifty feet—on top of the Board of Trade Building, and put 40,000 candlepower of arc lamps on top of it. It was thirty years and more before the incandescent light finally supplanted the arc for street lighting, and through all that time Sperry was trying to make an arc lamp with more light and fewer shadows.

He did it, finally, by putting a mineralized core into the positive carbon. On heating, this produces a substance known as carbide, which has a boiling point of 5000 degrees Fahrenheit. Carbon boils at 3700 degrees, and at that temperature gives off 160 candlepower of light per square millimeter of heated surface; and that is all the light which can be obtained from any solid at that temperature. In the Sperry arc as high as 1200 candlepower per square millimeter has been obtained. The sun delivers to the earth only 920 candlepower for each square millimeter of its radiating surface, so the Sperry arc is literally brighter than sunlight.

IT WAS the fame which his early feats in electric lighting won him that led to his being invited, in 1884, to join in organizing the American Institute of Electrical Engineers. Later he called the meeting which resulted in organization of the National Electric Light Association.

He won first prize in a competition for improved mining machinery, devising the first electrical equipment for mining coal, still used extensively. One piece was an "electric mule," with such powerful traction that a street-railway magnate asked Sperry to devise an electric street car which would climb hills. He did that, too, sold out his Chicago interests in 1893, and moved to Cleveland to manufacture street cars. Myron T. Herrick, now Ambassador to France, was treasurer of that Sperry Electric Railway Company, which soon sold out to the General Electric Company.

Sperry then turned to making electric automobiles and in so doing developed a storage battery so capacious that it became the foundation of a business which is still going on.

Versatile, ingenious, the traditional Yankee inventor type in its highest development, he is but a name to the general public, because of his personal modesty and diffidence.

PATENTS

At the right is a view of my drafting and specification offices where a large staff of experienced experts are in my constant employ.

My Patent Law Offices Just Across Street From U.S. Pat. Office

All drawings and specifications are prepared under my personal supervision.

Protect Your Ideas

Take the First Step Today—Action Counts

If you have a useful, practical, novel idea for any new article or for an improvement on an old one, you should communicate with a competent Registered Patent Attorney AT ONCE. Every year thousands of applications for patents are filed in the U. S. Patent Office. Frequently two or more applications are made for the same or substantially the same idea (even though the inventors may live in different sections of the country and be entirely unknown to one another). In such a case, the burden of proof rests upon the last application filed. Delays of even a few days in filing the application sometimes mean the loss of a patent. So lose no time. Get in touch with me at once by mailing the coupon below.

Prompt, Careful, Efficient Service

This large, experienced organization devotes its entire time and attention to patent and trademark cases. Our offices are directly across the street from the U. S. Patent Office. We understand the technicalities of patent law. We know the rules and requirements of the Patent Office. We can proceed in the quickest, safest and best ways in preparing an application for a patent covering your idea. Our success has been built on the strength of careful, efficient, satisfactory service to inventors and trademark owners located in every state in the Union.

Strict Secrecy Preserved—Write Me in Confidence

All communications, sketches, drawings, etc., are held in strictest confidence in strong, steel, fireproof files, which are accessible only to authorized members of my staff. Feel free to write me fully and frankly. Your case will have my personal attention. It is probable that I can help you. Highest references. But FIRST—clip the coupon and get my free book. Do THAT right now.

No Charge for Information On How to Proceed

The booklet shown here contains valuable information relating to patent procedure that every inventor should have. And with it I will send you my "Record of Invention" form, on which you can sketch your idea and establish its date before a witness. Such evidence may later prove valuable to you. Simply mail the coupon and I will send you the booklet, and the "Record of Invention" form, together with detailed information on how to proceed and the costs involved. Do this NOW. No need to lose a minute's time. The coupon will bring you complete information entirely without charge or obligation.

Clarence A. O'Brien

Registered Patent Attorney

Member of Bar of: Supreme Court of the United States; Court of Appeals, District of Columbia; Supreme Court, District of Columbia; United States Court of Claims.

PRACTICE CONFINED EXCLUSIVELY TO PATENTS, TRADEMARKS AND COPYRIGHTS

Inventors *Write for these.* Free Books

Mail this Coupon *Now*

CLARENCE A. O'BRIEN
Registered Patent Attorney
882, Security Savings & Commercial Bank Bldg., Washington, D. C.

Please send me your free book, "How to Obtain a Patent," and your "Record of Invention" form without any cost or obligation on my part.

Name .....

Address .....

.....

(Important: Print or Write name clearly)

PATENTS

Booklet Free — Highest References
Promptness Assured — Best Results
Send drawing or model for preliminary examination of Patent Office records.

All Business Given Prompt and Proper Attention

Listed Patent Lawyer in the latest editions of the Rand-McNally Directory of Bankers and Attorneys, of Chicago, Ill.; The Baggott & Ryall Directory of Attorneys, New York City; The Lawyers Guaranteed Directory, Detroit, Michigan; The Lawyers and Bankers Quarterly, published by the Legal Directory Publishing Company of St. Louis, Mo.; the American Lawyers Annual, Cleveland, Ohio.

WATSON E. COLEMAN,
REGISTERED PATENT LAWYER

Victor Building, 724 Ninth Street, N. W.
WASHINGTON, D. C.

WASHINGTON MONUMENT IN THE NATION'S CAPITAL

PATENTS

DON'T LOSE YOUR RIGHTS

TO PATENT PROTECTION

Before disclosing your invention to anyone send for blank form **"EVIDENCE OF CONCEPTION"** to be signed and witnessed. As registered patent attorneys we represent hundreds of inventors all over the United States and Canada in the advancement of inventions. The form "Evidence of Conception," sample, instructions relating to obtaining of patents and schedule of fees sent upon request.

LANCASTER & ALLWINE
274 Ouray Building
WASHINGTON, D. C.
Originators of forms "Evidence of Conception."

PATENTS

To the Man With an Idea

I offer a most comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model and description, for advice as to cost. Preliminary advice gladly furnished without charge.

My experience and familiarity with various arts, frequently enable me to accurately advice clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

IRVING L. McCATHRAN
PATENT LAWYER
Formerly with and successor to Richard B. Owen
201 Owen Building, Washington, D.C.
41-D, Park Row — New York City

TRADE-MARKS
REGISTERED

INVENTORS

who derive largest profits know and heed certain simple but vital facts *before* applying for Patents. Our book *Patent-Sense* gives those facts; sent *free*. Write **LACEY & LACEY**, 648 F St., Washington, D. C. Established 1869

1000 NEEDED INVENTIONS

Here is the most remarkable book ever offered to inventors. One Thousand needed inventions listed and described. Arranged as follows: General Problems; Automotive; Mechanical; Electrical; Chemical; Radio; Marine. Separate chapter on the Ten Most Needed Inventions. This book may give you one idea that will win you a fortune. Nothing else like it has ever been published. Compiled at enormous expense. Edited by Raymond Francis Yates, formerly Managing Editor of a leading scientific magazine. Over 100 pages, durably bound.

Send No Money

Cut out this advertisement and send it to us with your name and address plainly written and your copy of this remarkable book will be sent immediately. Pay the postman only $1.25 plus postage on arrival. Money back after 10 days' examination if desired. Limited edition. Write NOW. *(Outside U.S. $1.45 cash with order.)*

BUREAU OF INVENTIVE SCIENCE
Dept. 23 — Rochester, New York

INVENTIONS Commercialized

ON A CASH OR ROYALTY BASIS
PATENTED or UNPATENTED
In Business 25 Years · Complete Facilities · References
Write **ADAM FISHER MFG. CO.**
183-D Enright Ave. — St. Louis, Mo.

PATENTS

Trade-marks, Copyrights, Patent Litigation, Handbook with illustrations, 100 mechanical movements. Sent free on request.

ALBERT E. DIETERICH
Formerly member Examining Corp. U. S. Patent Office
Patent Lawyer and Solicitor
27 years' experience
681-A Ouray Bldg. — Washington, D. C.

If you want financial independence read the story "How a Big Load Was Lifted from Harry Wilson's Mind," on page four of this issue.

TRAVEL FOR "UNCLE SAM"

RAILWAY POSTAL CLERKS

$158 TO $225 MONTH

MAIL COUPON BEFORE YOU LOSE IT

Steady Work—No Layoffs—Paid Vacations
Travel—See Your Country
MEN—BOYS 18 UP
—Common Education Sufficient

Franklin Institute, Dept. W272,
Rochester, N. Y.

Sirs: Rush to me without charge, copy of 32-page book, "How to Get U. S. Government Jobs," with list of positions obtainable and full particulars telling how to get them.

Name .....

Address .....

Coal Too Useful to Burn

(Continued from page 49)

Moreover, this new process is combined with another process for making ammonia an important ingredient of fertilizers. Both processes involve subjecting coal gas to pressure of 15,000 pounds to the square inch and pumping it through steel tubes containing catalysts.

A catalyst is a substance which induces or hastens chemical actions of others. The catalysts make the coal gases form methanol (wood alcohol) and ammonia.

Here is an example of what may be expected from coal:

Several years ago chemists discovered that carbolic acid and formaldehyde mixed and heated under pressure form a solid material—now called bakelite after the inventor, Dr. Baekeland. Used for pipe stems, radio dials and panels, distributor boxes on automobiles, insulation, fountain pen barrels and so forth, bakelite and similar products have largely displaced hard rubber. Commercial manufacture of "cheaper" wood alcohol from coal will lower the production cost of bakelite because formaldehyde is made from wood alcohol. Bakelite will then be thoroughly a coal product and so even floor tiles may be made from coal!

Like a brick mason, the chemist rearranges the elements—carbon, hydrogen and oxygen—of which coal is composed, to build what he will that is composed largely of any or all of these elements—theoretically, even rubber.

Probably the most interesting recent development is the manufacture of oil and motor fuel from coal. The United States, possessing abundant natural supplies of petroleum, has surrendered the lead in this to chemists of Germany, France and England, where the natural supply is limited.

Four processes have been developed.

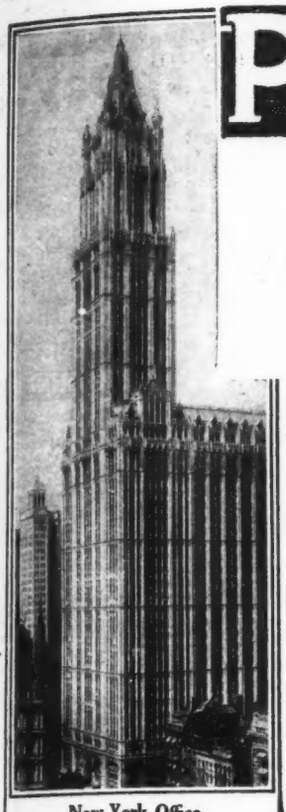
IN THE first, the coal is heated to a cherry red, at about 1200 degrees F., which drives out most of the oil and gas. The solid residue is an excellent smokeless fuel, resembling soft coke. The twenty-five to thirty gallons of tarry oil obtained from one ton of coal may be "cracked" to yield five or six gallons of a gasolinelike motor fuel. About 5000 cubic feet of rich gas is also obtained from one ton of coal.

The second method, the Bergius liquefying process, changes from thirty to fifty percent of the weight of the raw coal into oil. Powdered coal, mixed with enough oil or tar to form a thick paste, is pumped with hydrogen gas into a steel cylinder, producing a pressure of 3000 pounds to the square inch, which forces the hydrogen into combination with the coal, converting it from a solid to an oil. From 100 to 140 gallons is obtained from a ton of coal and refined into gasoline, kerosene, fuel and oils.

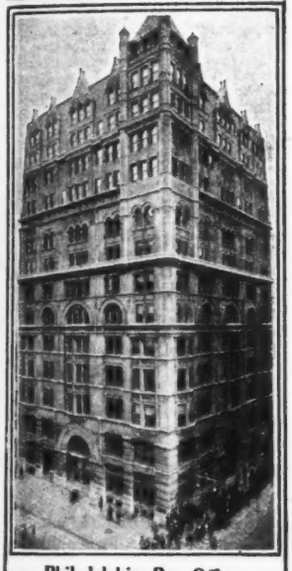
Refining of the oil to produce gasoline is obviated by "catalytic" processes developed by the Badische Company in Germany and by Patart in France, to make a pure synthetic motor fuel direct from coal gases. Water-gas, made by passing steam over red-hot coke or coal, is pumped up to enormous pressure and passed through copper-lined steel tubes heated electrically to a temperature of about 750 degrees F. Zinc and chromium compounds in these tubes cause the gases to form methanol. A ton of coal yields about 125 gallons, two gallons of which will drive an automobile as far as one gallon of gasoline. Estimated manufacturing cost, however, is between twenty and thirty cents a gallon, hence it is out of the picture for automobile fuel at present.

Dr. Franz Fischer of Germany is producing the most interesting of all these synthetic fuels. Recently he exhibited true gasoline, lubricating oil and solid paraffin, all made from coal. He passes water-gas over catalysts consisting of iron and cobalt heated to about 550 degrees F.

PATENTS TRADE-MARKS AND COPYRIGHTS



New York Office
Suite 1007 Woolworth Bldg.



Philadelphia, Pa., Office
Suite 518-519 Liberty Bldg.

Washington, D. C., Office
Victor Bldg.

OUR OFFER:

Your first step

Before disclosing an invention the inventor should write for our blank form "RECORD OF INVENTION." This should be signed, witnessed and returned to us together with model or sketch and description of the invention for INSPECTION and ADVICE *FREE*.

Our Five Books Mailed Free to Inventors

Our Illustrated Guide Book

HOW TO OBTAIN A PATENT

Contains full instructions regarding U. S. Patents. Our Methods, Terms, and 100 Mechanical Movements illustrated and described.

OUR TRADE-MARK BOOK

Shows value and necessity of Trade-Mark Protection. Information regarding *Trade-Marks and unfair competition in trade.*

OUR FOREIGN BOOK

We have Direct Agencies in Foreign Countries, and secure Foreign Patents in shortest time and at lowest cost.

Progress of Invention

Description of World's Most Pressing Problems by Leading Scientists and Inventors

**ALL COMMUNICATIONS AND DATA STRICTLY CONFIDENTIAL
INTERFERENCE AND INFRINGEMENT SUITS PROSECUTED**

IMPORTANT

HAVE YOUR CASE MADE SPECIAL TO AVOID DELAY. YOU SHOULD HAVE YOUR CASE MADE SPECIAL IN OUR OFFICE to save correspondence, secure protection and early filing date in the Patent Office. To secure special preparation of your case send $25.00 on account with model or sketch and description of invention.

***PROMPT SERVICE, HIGHEST REFERENCES
REASONABLE TERMS***

Private Office, Victor J. Evans, with view of Patent Office Through Window

VICTOR J. EVANS & CO., Patent Attorneys

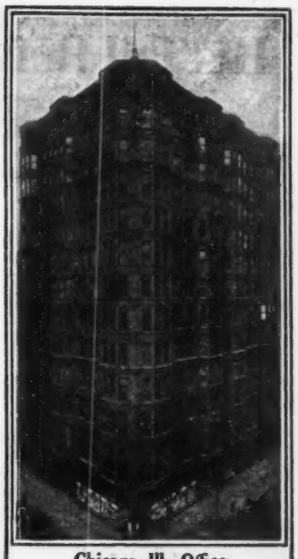
Main Offices: 694 Ninth St., Washington, D. C.

FREE COUPON

Gentlemen: Please send me FREE OF CHARGE your books as described above.

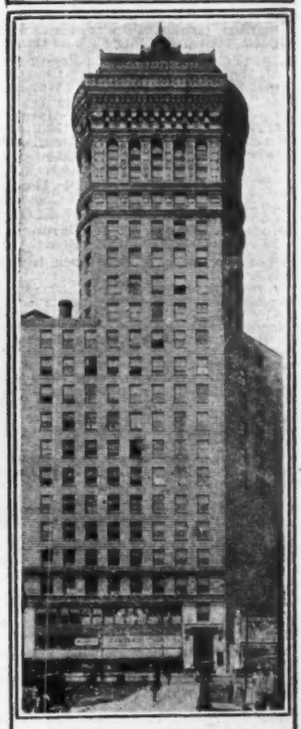
Name .....

Address .....



Chicago, Ill., Office
Suite 1114 Tacoma Bldg.

Pittsburgh, Pa., Office
Suite 514 Empire Bldg.



San Francisco, Cal., Office
Suite 1010 Hobart Bldg.

"His Tail Between His Legs"

What most men would see if they could see themselves

MOST men are being whipped every day in the battle of life. Many have already reached the stage where they have THEIR TAILS BETWEEN THEIR LEGS.

They are afraid of everything and everybody. They live in a constant fear of being deprived of the pitiful existence they are leading. Vaguely they hope for SOMETHING TO TURN UP that will make them unafraid, courageous, independent. But it never does. They continue to work and sweat and—MAKE OTHERS RICH AND HAPPY.

Some men, however, after years of cringing, turn on life. They CHALLENGE the whipper. They discover, perhaps to their own surprise, that it isn't so difficult as they imagined, TO SET A HIGH GOAL and reach it! Only a few try—it is true—but that makes it easier for those who DO try.

What about YOU? Are you ready to admit that you are through? Are you satisfied to keep your wife and children—and yourself—enslaved? ARE YOU AFRAID OF LIFE?

Success is a simple thing to acquire when you know its formula. The first ingredient is a grain of COURAGE. The second is a dash of AMBITION. The third is an ounce of MENTAL EFFORT. Mix the whole with your God-given faculties and no power on earth can keep you from your desires, be they what they may.

You can develop these God-given faculties as SIX HUNDRED AND FIFTY THOUSAND other people have done—through Pelmanism.

Pelmanism is the science of applied psychology, which has swept the world with the force of a religion. It has awakened powers in individuals, all over the world, they did not DREAM they possessed.

Famous people all over the world advocate Pelmanism, men and women such as these:

T. P. O'Conner, "Father of the House of Commons."
The Late Sir H. Rider Haggard, Famous Novelist.
General Sir Robert Baden-Powell, Founder of the Boy Scout Movement.
Judge Ben. B. Lindsey, Founder of the Juvenile Court, Denver.
Jerome K. Jerome, Novelist.
Frank P. Walsh, Former Chairman of National War Labor Board.
General Sir Frederick Maurice, Director of Military Operations Imperial General Staff.
Admiral Lord Beresford, G. C. B., G. C. V. O.
Sir Harry Lauder, Comedian.
W. L. George, Author.
Baroness Orczy, Author.
Prince Charles of Sweden

and others, of equal prominence, too numerous to mention here.

A remarkable book called "Scientific Mind-Training," has been written about Pelmanism. IT CAN BE OBTAINED FREE. Yet thousands of people who read this announcement and who NEED this book will not send for it. "It's no use," they will say. "It will do me no good," they will tell themselves. "It's all tommy-rot," others will say.

If you are made of the stuff that isn't content to remain a slave—if you have taken your last whipping from life—if you have a spark of INDEPENDENCE left in your soul, write for this free book. It tells you what Pelmanism is, WHAT IT HAS DONE FOR OTHERS, and what it can do for you.

The first principle of YOUR success is to do something radical in your life. You can not make just an ordinary move, for you will soon again sink into the mire of discouragement. Let Pelmanism help you FIND YOURSELF. Mail the coupon below now—now while the resolve to DO SOMETHING ABOUT YOURSELF is strong.

THE PELMAN INSTITUTE OF AMERICA
Approved as a correspondence school under the laws of the State of New York
71 West 45th Street Suite 873 New York City

The Pelman Institute of America,
71 West 45th Street, Suite 873, New York City.

I want you to show me what Pelmanism has actually done for over 650,000 people. Please send me your free book, "Scientific Mind-Training." This places me under no obligation whatever.

Name.....

Address.....

City.....State.....

D

Here Are Correct Answers to Questions on Page 63

1. The town of Hammerfest, near the northern extremity of Norway. Settlements farther north in Spitzbergen and at Etah, Greenland, are not large enough or permanent enough to be called towns. In a straight line Hammerfest is only about 1300 miles from the North Pole.

2. The quality of the milk used and the care taken in the churning have combined to give Danish butter a world-wide reputation. It is sold as a luxury almost everywhere, even in Australia and New York.

3. Off the mouth of the Amazon River, whose power takes it that far.

4. In Australia the government, in order to reconcile certain native tribes to the laws against wife-beating, whips wives for husbands who can prove them guilty of wrong doing. The same law applies to guilty husbands.

5. The large variety of one-shelled sea snail known as the abalone is an inhabitant of many of the shores of the Pacific Ocean, especially on the Isla de Cedros or "Isle of Cedars," on the west side of the Bay of Sabastian Vizcaino.

6. This is true of Sitka and to some extent even of the city of Juneau, a little farther north. A current of warm water flows across from the coast of Japan and warms the Alaskan coast.

7. Goldfish of the colored varieties do not live wild anywhere in the world. They are raised for market, just as fine dogs are. The largest goldfish "farm" in the United States is near Martinsville, Ind. The fish also are raised in large numbers in Maryland, Iowa, and Kansas.

8. This curious name is given to the flat, lakelike expanses of hard clay that are encountered in the desert parts of California and Nevada. In most cases these clay plains really are the bottoms of ancient lakes.

9. This is the famous Lake Magadi, south of the town of Nairobi in Kenya Colony. This lake is a small, dried-up remnant of a larger lake. At the bottom is a bed of crystallized soda of the kind known as washing soda. It is shipped to Europe.

10. This word comes from two Greek words and means literally "with the feet opposite." It is given to the countries directly on the other side of the earth from northwestern Europe, especially Australia. The reason for this name is the fact that people living on the opposite side of the earth from us have their feet toward ours.

11. In China, Japan, and more or less generally throughout the Far East, religious persons write prayers on paper, which is then burned in a ceremonial fire. It is possible to buy in the market places bits of bright colored paper on which prayers have been printed in advance, all ready for use.

12. In the year 586 B.C. Nebuchadnezzar, King of Babylon, captured Jerusalem and burned the famous temple, which had been built nearly 400 years before by King Solomon. The temple was utterly destroyed. Even the site of it was forgotten. It is now believed, however, that it stood on the crest of one of the hills, called the Eastern Hill, of the modern city of Jerusalem. The temple probably stood not far from the so-called Sacred Rock, over which now stands the Mohammedan building known as the Mosque of Omar.

START to PLAY Very First Day!

Extra Money, Hosts of Friends, Loads of Fun Can Be Yours!

FREE easy lessons enable you to play this amazing instrument at once, even if you can't read a note of music right now! Surprise and delight your friends. Make big money at dances, entertainments and socials. Earn $5 to $25 extra for work that is play. Wonderful for the home. No teacher necessary, free lessons show you how.

Earns $60.00 a Week

Ralph Smith, Chicago, says: "Played 20 minutes at wedding. Received $20." L. E. Hallman, Reading, Penna., writes: "Made $300 in 6 weeks—spare time."

YOU can play the Xylorimba

Five Days Free Trial—Year to Pay. Big Free Book tells how you can play the Xylorimba in your own home for five days and evenings at our risk and outlines our special terms that make it easy for you to own a Xylorimba. If you want more fun out of life, more friends and boosters, more money than you've ever earned before, send for Free Book today.

J. C. DEAGAN, Inc., Dept. 1653, 1770 Berteau Ave., Chicago
Please send me, without obligation, full details of the Free Trial offer and easy-payment plan on the Deagan Xylorimba.

Name _____

Address _____

Electricity!

Learn in Los Angeles

Be an electrical specialist. Gain quick success in this most fascinating and profitable field. Learn at National in the center of tremendous electrical projects costing more than $100,000,000.00—unlimited opportunities now.

Practical, intensive training by National's job-experience method in 6 to 9 months. All technical essentials included. School endorsed by leaders in electrical industry. You learn all branches of electricity; radio. Million dollar institution; all modern equipment and training facilities. Life scholarship. No age limit. Free employment service. Over 17,000 successful graduates. 23rd year. Big, illustrated 84-page catalog sent FREE. Write today.

FREE BOOK

NATIONAL ELECTRICAL SCHOOL
Dept. 284, 4006 So. Figueroa, LOS ANGELES, CALIF.

PREPARE FOR AN

ART CAREER

—thru the only art school operated as a department of a large art organization, who have actually produced over a quarter million drawings for leading advertisers. Where else can you get so wide an experience? Home study instruction. Write for illustrated book telling of our successful students.

MEYER BOTH COMPANY
Michigan Ave. at 20th St. Dept. 35, Chicago, Ill.

Anyone CAN LEARN!

No talent or experience necessary. Fascinating work. Pays big money. Complete instruction book TELLS ABOUT: Alphabets, Colors, HOW TO MIX PAINTS, Show Cards, Window Board and Wall Signs, Ready made letters, Gilding, TRICKS OF THE TRADE, also gives 100 Alphabets and Designs. Book bound in flexible Imit. leather, gold edges, and four ball bearing Show Card Pens. Book and Pens sent postpaid for $3.00. (C. O. D. 10c extra.)

$3.00

OzziePub.Co.,37RoseSt.,Dept. 72,NewYork

EARN MONEY IMMEDIATELY—
WE FURNISH EQUIPMENT TO START

BECOME AN EXPERT

ACCOUNTANT

Executive Accountants and C. P. A.'s earn $3,000 to $10,000 a year. Thousands of firms need them. Only 9,000 Certified Public Accountants in the United States. We train you thoroly at home in spare time for C.P.A. examinations or executive accounting positions. Previous experience unnecessary. Training under the personal supervision of William B. Castenholz, A. M., C. P. A., and a large staff of C. P. A.'s, including members of the American Institute of Accountants. Write for free book, "Accountancy, the Profession that Pays."

LaSalle Extension University, Dept. 383-H Chicago
The World's Largest Business Training Institution

The Movie Maker

(Continued from page 38)

approximate locations he was to find and photograph. He also informed Bozo that he had wired for reservations on a fast boat between New York and Liverpool.

That evening Don hurried home, whistling thoughtfuliy. In his pocket was the signed lease and contract, running for four months. At the conference in Eckstein's office that afternoon, Margaret Moreland had appeared and, much to the surprise of the president of Popular Players, had added her signature without protest. As Don climbed the two flights to his attic apartment, his mind was busy with schemes for the immediate raising of further cash. He had sold Margaret's sapphire ring that morning for six thousand dollars. Reluctant to accept aid in such a fashion, he resolved that even if the picture failed he would eventually repay her. But now it was to her advantage, even more than to his own, to throw everything into the balance for immediate success.

HE STEPPED into his apartment quietly, unnoticed by the professor, who was deeply absorbed at a long table near one of the windows.

Don's home could be called an apartment only through courtesy—or imagination. In reality, it was a workshop where he and the professor slept. Originally it had been the ample, undivided third story of a huge old house in a dilapidated section of Los Angeles, but Don had partitioned it into a small bedroom and a very large, unadorned studio. One windowless side was boarded off into a dark room. On the north side, he had cut a large square out of the roof and constructed, with fair skill, a ground-glass skylight.

All about the big room was a clutter of photographic background screens, motion picture lighting standards and paraphernalia, and an orderly tangle of electric wires. The most interesting parts of the studio, however, were the professor's long worktable and the shelves he had built against the wall near by. The old man's interest in the technical side of motion pictures apparently had burst into full bloom that night, three years before, when Don had unexpectedly met him coming out of a neighborhood picture house. Since then, Professor Mahrlenburg had spent hours every day making perfect miniatures of motion picture scenes and properties. Three shelves were crowded with ancient ship models. Filling three other shelves was a zoo of perfectly constructed animals of every sort and description, including tiny prehistoric monsters. Painted masks that seemed grotesquely alive stared down from the top shelves.

ON A long table, over which the old man was bending so intently that he had not heard Don enter, was a clutter of wheels, steel spirals, and miniature machinery. Peculiar geometrical designs cut out of metal disks or papier mache were stacked loosely at one end of the table. On a small rack before him were arranged a dozen disks of a different type, each a little larger than a silver dollar, but of varying thicknesses. Some of these were glass, but the majority were fine pieces of gauze or transparent silk drawn tight in little metal rings. The professor was examining a similar disk under a large microscope clamped to his table.

He looked up triumphantly when Don spoke.

"This one dried perfectly," he announced. "My Gretchen will look like sixteen when we use it on the lens."

He placed the disk in the rack with the others, took from his eye a small magnifying glass he wore like a monocle, and smiled mysteriously at Don.

"I have a surprise for you, my son," he remarked.

(Continued on page 168)

PATENTS

TRADE-MARKS , DESIGNS
FOREIGN PATENTS

MUNN & CO.

PATENT ATTORNEYS

Associated since 1846 with the Scientific American

SCIENTIFIC AMERICAN BUILDING
24 W. 40th St., *New York City*

SCIENTIFIC AMERICAN BUILDING
Washington, D. C.

TOWER BUILDING
Chicago, Ill.

VAN NUYS BUILDING
Los Angeles, Cal.

HOBART BUILDING
San Francisco, Cal.

Books and Information on Patents and Trade-Marks by Request

Associates in all Foreign Countries

IF YOU **STAMMER**

Attend no institute until you get my free book "Millard's Advanced Natural Corrective Course" and a free copy of my Natural Speech Magazine. Est. 24 years. 10,000 cases successfully treated. Largest school for stammerers in the world. Positive results guaranteed. Graduates everywhere. **Millard Institute of Normal Speech, 2336 Millard Bldg., Milwaukee, Wis.**

AGENTS 500% PROFIT
GENUINE GOLD LEAF LETTERS

Guaranteed to never tarnish. Anyone can put them on stores and office windows. Enormous demand, large profits, Paul Clark says: smallest day $28.70. R. L. Reel made $920 in two months. Write today for free sample and liberal offer to general agents.

METALLIC LETTER CO., 433A N. Clark Street, Chicago.

INVENTORS SERVICE BUREAU

Prepares and files applications for patents and trademarks. Makes patent searches. Negotiates sale of patents. A complete service for the inventor. Low rates. Easy terms. Secrecy guaranteed. Write for particulars.

BOX 1648 WASHINGTON, D. C.

By the famous Landon Picture Chart Method

This method of teaching has become nationally famous because of the successful results it has produced for hundreds of beginners who liked to sketch or copy. The Picture Chart Method of teaching develops originality, and has thus opened the door to success for many well-known cartoonists of today, who are now earning from $75 to $200 or more per week.

Make This Interesting Test

Whether you think you have talent or not, send for a Sample Chart to test your ability. With this chart I will send you samples of the work of successful students of this school and facts about cartooning which show the possibilities for you. Please enclose 6¢ in stamps to cover postage, and state your age.

Address C. N. Landon

THE LANDON SCHOOL
4051 National Bldg., Cleveland, Ohio

INVENTORS PROTECT YOUR IDEAS

Send for our Guide Book, **HOW TO GET YOUR PATENT,** and Evidence of Invention Blank, sent Free on request. Tells our terms, methods, etc. Send model or sketch and description of your invention for **Inspection and Instructions Free. Terms Reasonable. Best References.**

RANDOLPH & CO.
Dept. 130, Washington, D. C.

NAME.....

STREET.....

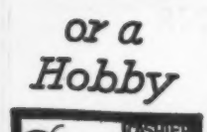
CITY.....STATE.....

If You Want a Job

or a Hobby

that Pays Well

Where You can be Your Own Boss



and Keep Your Own Hours

learn Illustrating

SEND for our free catalog "A Road To Bigger Things." Learn how former Federal School graduates now earn big money. See the work and comments of famous artists like Clare Briggs, Norman Rockwell, Fontaine Fox, Neysa McMein and over fifty others.

Opportunities in drawing have never been better. The Federal Course includes illustrating, cartooning, lettering, window card illustrating, etc.

If you like to draw, train your talent. We inclose a test chart with our catalog. It finds out your ability. Fill out the coupon now.

Federal School of Illustrating

Federal School of Illustrating,
3148 Federal School Bldg.,
Minneapolis, Minn.

Name ..... Age .....

Occupation .....

Address .....

The Movie Maker

(Continued from page 167)

Only slightly interested, Don waited while the professor put on his spectacles with great ceremony, fumbled at length in his pocket, and drew out a long slip of paper. He handed it to Don.

It was a certified check, signed by Otto Mahrlenburg and payable to Donald Kennedy, for twelve thousand dollars!

Don stared blankly from the check to the professor, and back to the check again. Yes, it was certified! But where could the old man have obtained such a sum? He had been nearly starving when Don had taken him in, and he apparently had no friends. While living with Don, he had worked up a small business of amateur kodak picture finishing, making enough for his small expenses and for the materials needed in his model making. But he could have saved no money, Don was sure.

YET the professor was smiling blandly, as though accustomed to giving away thousands of dollars every day.

"It looks real," Don commented, rubbing the check between his fingers. "It feels real, and, by golly, I believe it *is* real, but how in the—"

The professor seemed slightly embarrassed. "My daughter—"

"We can't take any more from Miss Moreland!" Don interrupted.

"This money my daughter deposited for me in a bank years ago," explained the old man with dignity.

"You mean you could have had it three years ago when you were practically starving?" asked Don incredulously.

The old man drew himself up in injured pride.

"It is for the father to support his daughter, not the daughter her father," he declared. "Now, only, can I use it because it will be for her."

* * *

September first. Cinema City was almost depopulated. Two or three smaller independent companies continued production there, but with the big units of Popular Players gone, the place looked deserted. At one end of the lot, however, several workmen were erecting ten-foot wooden supports in the form of a huge circle. From this group a long-legged young man, his red hair flaming in the sun, walked rapidly across the lot to Stage No. 3. He hurried inside the big shed to a dismantled set, where three of his little company awaited him, dressed in medieval costumes.

"Fine!" He looked them over critically. "How does it feel to be an actor again, Jerry?"

"Right this minute I'd like to be zooming five thousand feet up, with a cold wind blowing me through the clouds." Jerry wriggled uncomfortably in a heavy costume of chain mail. "This is not my idea of a Palm Beach suit."

"We'll start shooting right away," Don promised. "Only a few close-ups today. Miss Moreland, are you ready to run through a scene? I'd like to see how Jerry registers."

WHAT he really wanted, however, was to test a combination of lighting effects and the professor's lens screens on Margaret. He had watched her work under other directors and believed that the strained expression of her face was due partly to her fear that she was failing. Now, chatting casually about the very modern and highly efficient mechanical equipment of the stage, he apparently concentrated on Jerry, asking Margaret occasionally to help the greenhorn actor put across his scenes.

The play was a story of the great war, with Jerry an aviator and Margaret an English war nurse in France. This was only the shell of the story, however, for when Jerry crashed just behind the enemy (Continued on page 169)

Big Money in Poultry

Eggs Turn into DOLLARS FAST!

Make $1,000 a Year in Spare Time—Easy

Lots of room for YOU in the poultry business. 85% of the people in this country live in cities. EVERYBODY eats eggs and poultry meat—but only 15% produce them. Why not let the "other fellow" pay YOU the fancy prices? Easy to get started in back yard, on vacant lot, or farm. We GUARANTEE success if you follow our methods. We show you how to feed for eggs, in winter, when eggs are high in price; how to cut feed bills; how to keep flocks healthy; how to tell laying hens, PAY-BIRDS, from loafers. Our course, produced by eighteen famous experts, endorsed by 30 leading agricultural schools, gives you thousands of sure, proved, tested Methods that make PROFITS CERTAIN. FREE book tells what we're doing for others—and what we can do for you.

Others Say:

"You have opened up to me a pleasant and profitable way of gaining an independent living."
Seldon Anderson, R. I.

"When I enrolled for your course, I knew nothing about poultry keeping. I am now successfully operating a commercial poultry farm."
W. J. Warthen, Conn.

"Your course was a splendid investment. I recommend it for both beginners and experienced poultrymen."
Y. W. Ow, Hawaii.

Mail Coupon Today

Mail this now

The National Poultry Institute
Washington, D.C. Dept. 413-F

I am interested in your plan on "How to Raise Poultry for Profit." Send me your FREE book, without obligation on my part.

Name .....

Address .....

$75 to $125 Weekly Charging Batteries Starts You

$5 Down

Let me show you how to make big money right from the start. I've prepared a FREE book explaining all details. First week's profit pays for all equipment. You can get all the battery charging business in your community with my Service Station Charger—it's years ahead of ordinary chargers—handles 50% to 70% more batteries. I explain everything—start you in a business of your own and put you on the way to big money. Write for FREE BOOK.

C. F. HOLMES, Chief Engineer, Dept. P.S.
Independent Electric Works
5116 Ravenswood Ave. Chicago, Ill.

Big Profits

FREE BOOK-Just Out

Don't Envy The Plumber BE ONE!

$11.00-$16.00 PER DAY and work EVERY day, is the Plumber's wage.

Every skilled workman will tell you that Plumbers have the best of it. WINTER and SUMMER the Plumber is busy at top wages. No skilled Plumber is ever out of a job—compare his opportunities with any trade, plus the opportunities of having your own shop.

We teach you Plumbing with TOOLS (not books) under Licensed Master PLUMBERS in one of the finest equipped schools in America. We make you a Plumber, every branch is taught thoroughly—Lead Work—Blue Print for plan reading—all other tricks.

LEARN IN 8 to 12 WEEKS without previous experience.

If you are making less than $60.00 a week you owe it to yourself to investigate. Get FREE catalog that tells in pictures and words how we teach this trade. Special rates now.

UNIVERSAL PLUMBING SCHOOL
2031 Troost Ave. KANSAS CITY, MO.

Skin Troubles

Cleared Up—often in 24 hours. To prove you can be rid of pimples, blackheads, acne, eruptions on the face or body, barbers' itch, eczema, enlarged pores, oily or shiny skin, simply send me your name and address today—no cost—no obligation. CLEAR-TONE tried and tested in over 100,000 cases—used like toilet water—is simply magical in prompt results. You can repay the favor by telling your friends; if not, the loss is mine. WRITE TODAY.

E. S. GIVENS, 458 Chemical Bldg., Kansas City, Mo.

The Movie Maker

(Continued from page 168)

lines and crawled out, wounded, to lose consciousness on no man's land, his hallucinations took him back to another life—to England of the twelfth century at the time of one of the Crusades, when he was a Norman noble and Margaret a Saxon lady. The action of this central part of the story concerned Jerry's adventures as leader of a band of crusaders. To be near him, Margaret disguised herself as a knight, taking Judy, her little maid, along as a page. The journey through England and France, over the Alps, across the Mediterranean to Constantinople, and on to the siege of Jerusalem, gave an opportunity for a spectacle motion picture of colorful adventure. Bozo Biddle and his camera were to collect the local color and send it back in cans of film across the Atlantic, while all the actual adventuring was to be done on the lot at Cinema City.

THE sequence Don had chosen for his test was designed to take place near the castle in old England. To control his lighting effects, he had decided to photograph the scene on a three-sided box set of Stage No. 3, lined with heavy white muslin. As he set the camera in position, he called Jerry's attention to the huge electric light bulbs, protected by wire housings, which were mounted on a bridge above the set.

"That's why I chose this stage," he explained. "It's the only one on the lot equipped with incandescent lamps in place of the carbon bridge lights. Stand here, will you, Jerry?"

"But think of the juice they'll use," objected Jerry, taking his place about six feet in front of the camera. "Wouldn't carbons be much cheaper?"

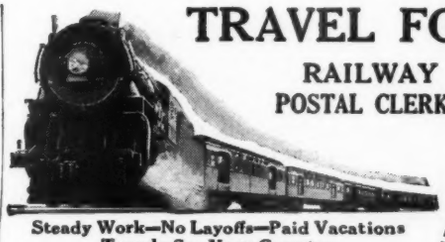
"Not when you figure salaries," explained Don, squinting at Jerry through the finder. "There must be a man to every two carbon lights, as well as chief electrician, and we use at least ten carbons for any interior, sometimes eighteen or twenty—Miss Moreland, will you take your place here?—and the men are on the payroll eight hours a day, even if we use the lights only fifteen minutes. But one man can operate the whole row of electric bridge lights. That'll save us thousands of dollars."

"Edison again to the rescue," murmured Jerry.

Satisfied at last with the camera angle, Don handed Judy a tape line. While she held it even with the lens, Don stretched its length to Jerry's nose, then stooped and chalked a rough semicircle on the floor. Cautioning them not to step outside the mark, Don moved to the switchbox at one side of the set and threw on the full blaze. From the scaffolding above, thirty thousand watts of electricity rained down on them, flooding every square foot of the set with even, shadowless illumination.

AND then Don began to paint out the lines and hollows of Margaret's face with additional light. A baby spot, focused to spread its rays just below her chin, removed a wrinkle with painless surgery. A bank of mercury lights, placed low on the other side to throw back a counter light against the downward glare from the bridge, erased the laughing lines from her nose to the corners of her mouth. The tiny crow's-feet about her eyes, the faint vertical lines between her brows, no light manipulation could remove, Don knew. These he left to be ironed out by the microscopic diagonal threads of the professor's screen. Slipping it into place over the lens, he called for action and began to crank the camera. Next week he would have a camera man, but for the first few days he wanted to test every operation himself. A few days and several hundred feet of film sacrificed for experiment at the beginning of the picture would save weeks of delay and thousands of feet from being wasted later.

(Continued on page 170)



TRAVEL FOR "UNCLE SAM"

RAILWAY POSTAL CLERKS $158 TO $225 MONTH

Mail Coupon Before You Lose It

Steady Work—No Layoffs—Paid Vacations
Travel—See Your Country
MEN—BOYS 18 UP
Common Education Sufficient

Franklin Institute, Dept. W274, Rochester, N. Y.
Sirs: Rush to me without charge copy of 32-page illustrated book, "How to Get U. S. Government Jobs," with list of positions obtainable, and full particulars telling how to get them.

Name.....

Address.....

GOV'T. POSITIONS

$35 TO $75 WEEKLY

MEN-WOMEN AGE 18 to 55

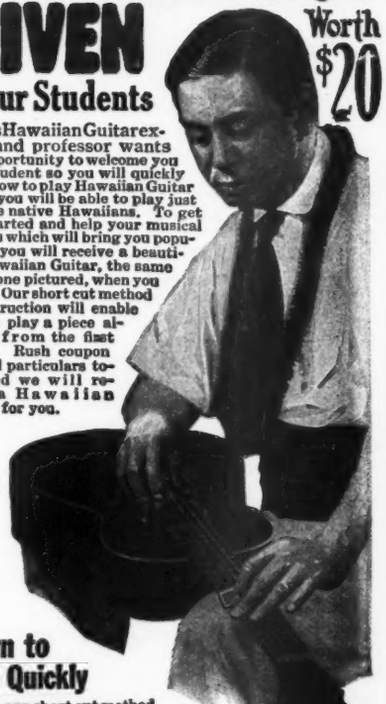
( ) Ry. Mail Clerk	( ) Steno-Typist
( ) Forest Ranger	( ) Immigrant Inspector
( ) R. F. D. Carrier	( ) Seamstress
( ) Special Agent (investigator)	( ) Auditor
	( ) Steno-Secretary
( ) City Mail Carrier	( ) U. S. Border Patrol
( ) Meat Inspector	( ) Chauffeur-Carrier
( ) P. O. Clerk	( ) Watchman
( ) File Clerk	( ) Skilled Laborer
( ) General Clerk	( ) Postmaster
( ) Matron	( ) Typist

INSTRUCTION BUREAU, 224 Arcade Bldg. St. Louis, Mo. Send me FREE particulars How To Qualify for positions marked "X", Salaries, locations, opportunities, etc.

NAME.....

ADDRESS.....

Hawaiian Guitar GIVEN Worth $20 to our Students



This Hawaiian Guitar expert and professor wants the opportunity to welcome you as a student so you will quickly learn how to play Hawaiian Guitar—yes, you will be able to play just like the native Hawaiians. To get you started and help your musical success which will bring you popularity, you will receive a beautiful Hawaiian Guitar, the same as the one pictured, when you enroll. Our short cut method of instruction will enable you to play a piece almost from the first lesson. Rush coupon for full particulars today and we will reserve a Hawaiian Guitar for you.

Learn to Play Quickly

With our short cut method of instruction you will quickly learn how to play Hawaiian Guitar which will bring you popularity and social success. You learn to play from notes. If you never had any musical training, you will quickly get on, because our experts have perfected a course of home instruction which is as simple as learning A, B, C's.

PICTURE and PHONOGRAPH RECORD METHOD EASY We don't depend upon printed lessons only for your success, but we furnish pictures of our professors playing, diagrams, charts and phonograph records for each lesson. This practically brings our professors from our studio to your home and enables you to listen to their playing just as if they were actually in front of you. To prove this is easy, we will send you your first lesson free.

RUSH COUPON—Send No Money

So positive are we that you will become one of our students, we will send free without obligation, our first lesson. Also receive our free big book which gives particulars about our course. Write for your free book and your free lesson today.

HAWAIIAN STUDIO No. 56038
of New York Academy of Music
100 Fifth Avenue, New York, N. Y.

Please rush your free book, "How to Learn Hawaiian Guitar" and my first lesson. Also reserve a Hawaiian Guitar for me. This obligates me in no way whatever.

Name.....

Address.....

A definite program for getting ahead financially will be found on page four of this issue.

The Letter That Saved Bob Johnson's Job

—and paved the way for a better one!

IT was written to his employer by the International Correspondence Schools. It told how "Robert Johnson had enrolled for a course of home-study and had received a mark of 94 for his first lesson."

Bob answered the summons to the Chief's office with just a little fear and trembling, for a lot of men were being dropped—a lot more were having their pay reduced.

But as Bob came in, his employer did a surprising thing. He got up quickly from his desk and grasped Bob warmly by the hand.

"I want to congratulate you, young man, on the marks you are making with the I. C. S. I am glad to see that you are training yourself not only for your present job but for the job ahead.

"We're cutting the pay-roll. Until I received this letter, I had you in mind as one of the men to be dropped. But not now. Keep on studying—keep your eyes open—and pretty soon there'll be a still better job for you around here. We're always looking for trained men."

Won't you let the I. C. S. help you, too? Won't you trade a few hours of your spare time for a good job, a good salary and the comforts that go with it? Then mark the work you like best on the coupon below and mail it to Scranton today. That doesn't obligate you in the least, but it will be your first big step towards success. *Do it now!*

INTERNATIONAL CORRESPONDENCE SCHOOLS
"The Universal University"
Box 7666-E, Scranton, Penna.

Without cost or obligation, please send me a copy of your booklet, "Who Wins and Why," and full particulars about the subject *before* which I have marked X:

☐ Industrial Management	☐ Business Correspondence
☐ Personnel Management	☐ Show Card and Sign Lettering
☐ Traffic Management	
☐ Accounting and C.P.A. Coaching	☐ Stenography and Typing
☐ Cost Accounting	☐ Civil Service
☐ Bookkeeping	☐ Railway Mail Clerk
☐ Salesmanship	☐ Common School Subjects
☐ Secretarial Work	☐ High School Subjects
☐ Spanish ☐ French	☐ Magazine and Book Illustrator
☐ Advertising	☐ Cartooning

TECHNICAL AND INDUSTRIAL COURSES

☐ Electrical Engineer	☐ Architect
☐ Electric Lighting	☐ Architects' Blueprints
☐ Mechanical Engineer	☐ Contractor and Builder
☐ Mechanical Draftsman	☐ Architectural Draftsman
☐ Machine Shop Practice	☐ Concrete Builder
☐ Railroad Positions	☐ Structural Engineer
☐ Gas Engine Operating	☐ Chemistry ☐ Pharmacy
☐ Civil Engineer	☐ Automobile Work
☐ Surveying and Mapping	☐ Airplane Engines
☐ Metallurgy ☐ Mining	☐ Agriculture and Poultry
☐ Steam Engineering ☐ Radio	☐ Mathematics

Name.....

Street Address.....

City..... State.....

Occupation.....

If you reside in Canada, send this coupon to the International Correspondence Schools Canadian, Limited, Montreal

HIGH SCHOOL COURSE IN TWO YEARS

YOU ARE BADLY HANDICAPPED if you lack High School training. You cannot attain business or social prominence. You are barred from a successful business career, from the leading professions, from well-paid civil service jobs, from teaching and college entrance. In fact, employers of practically all worth-while positions demand High School training. You can't hope to succeed in the face of this handicap. But you can remove it. Let the American School help you.

FIT YOURSELF FOR A BIG FUTURE This course, which has been prepared by some of America's leading professors, will broaden your mind, and make you keen, alert and capable. It is complete, simplified and up-to-date. It covers all subjects given in a resident school and *meets all requirements* of a High School training. From the first lesson to the last you are carefully examined and coached.

USE SPARE TIME ONLY Most people *idle* away *fifty* hours a week. Probably you do. Use only one-fifth of your wasted hours for study and you can remove your present handicap within *two years*. You will enjoy the lessons and the knowledge you will gain will well repay the time spent in study.

Check and mail the coupon NOW for full particulars and Free Bulletin.

American School
Dept. H-375,
Drexel Ave. and 58th St., Chicago

American School
Dept. H-375, Drexel Ave. & 58th St., Chicago
Send me full information on the subject checked and how you will help me win success.

.....Architect	.....Business Law
.....Building Contractor	.....Lawyer
.....Automobile Engineer	.....Machine Shop Practice
.....Automobile Repairman	.....Mechanical Engineer
.....Civil Engineer	.....Shop Superintendent
.....Structural Engineer	.....Employment Manager
.....Business Manager	.....Steam Engineer
.....Cert. Public Accountant	.....Foremanship
.....Accountant and Auditor	.....Sanitary Engineer
.....Bookkeeper	.....Surveyor (& Mapping)
.....Draftsman and Designer	.....Telephone Engineer
.....Electrical Engineer	.....Telegraph Engineer
.....Electric Light & Power	.....High School Graduate
.....General Education	.....Wireless Radio
.....Vocational Guidance	.....Undecided

Name .....

Address .....

The Movie Maker

(*Continued from page 169*)

Jerry and Margaret, with Judy appearing briefly now and then, ran through their scene lightly, with a good comedy touch. Don grinned appreciatively as he observed Jerry putting in bits of action that had not been rehearsed. He had no fear for Jerry's performance. The man was a born actor. Entirely without self-consciousness, his thoughts translated themselves into action and facial expression without effort. And being blessed with a keen sense of humor, he enlivened any scene in which he appeared. Don wondered if the leading man might not unconsciously steal the picture from the star. But Margaret was playing up to him with a dash and animation that revealed an unknown phase of her ability as an actress.

LATE that afternoon the five met in the projection room to see the first rushes of the big picture, and a little sigh of pleasure sounded in the darkened room as Margaret's face appeared on the screen. Firm, rounded, alive with vivacity, the beautiful face looked as though a kind hand had swept over it, smoothing out all telltale lines and hollows. But who was the ghastly-faced man playing opposite her? Only the sparkling dark eyes were Jerry; the rest was a flat dead mask, grimacing.

"What *is* the matter with him!" groaned Judy.

"Too much make-up," murmured Don.

"But we had to lay it on thick," protested Jerry's disappointed little sister, "he's so dark."

When the lights went up, Jerry faced the others with an apologetic grin.

"If I had any vanity," he remarked, "I'd go out and shoot myself. Now I see why I never got any farther than doubling for the handsome hero."

"Come over to the stage again," suggested Don. "I'll try some more shots if you don't mind. No need for the rest of you to stay."

For three hours, until even Jerry's tanned and toughened skin began to feel tender, Don made up his face with different shades of grease paint and powder, shooting a few feet of film for each new make-up—heavy pink, flesh, chalk-white, pale yellow. One test he made with Jerry's skin in its natural state. This showed the best results in the projection room next day. But even so, though the ghastly effect was overcome, he looked as swarthy as a Mexican laborer.

"That'll be fine when he doubles as his villainous half-brother," commented Don, finding a ray of hope in the gloom.

"YES, but how are we going to fix him up to look like the hero?" asked Judy, almost in despair. In rewriting the scenario so that Jerry could play the double rôle of hero and villain, she had congratulated herself on saving the salary of an additional actor. Now it looked as though a new leading man must be hired.

"Why not have Louis Menzies diagnose his face?" Margaret suddenly suggested.

"The make-up wizard?" asked Don.

"Yes. I want him to help me with my own, too."

The worried five piled hopefully into Jerry's car and set out for a small dark building in Hollywood where for ten years a little man with stubby fingers had been practicing his art of shining the stars whose luster was fading—bringing back the peach bloom of youth with the right shade of grease paint; straightening crooked noses with a shadow pencil; concealing scars, and imparting natural curves to flat, expressionless lips.

Louis Menzies frowned and shook his head when he had seen the tests.

"You couldn't fade him out successfully," he indicated Jerry, "even if you whitewashed him."

"What can we do with him, then?" asked Don, as despair settled over the little group.

Louis Menzies was fumbling among the boxes and bottles on his shelves.

"Use this." He handed Don a stick of dark ochre grease paint.

"But it's almost brown!" protested Don. "He'll look like the end man in a minstrel."

"Use it!" commanded the wizard, and turned his attention to Margaret.

"Rouge a little higher and toward the outer edges of the eyes," he suggested, "about here." Tilting her chin, he turned her face toward the light and dabbed her cheek bones near the temples with a puff filled with rose-pink rouge. "It will take away that little flatness caused by lack of shadows."

"And this young lady," he looked at Judy, "must use a pale flesh grease paint."

"But I'm almost as dark as my brother," she remarked, wonderingly.

"No matter," replied the great man. "We expect women to have white skins on the screen—and your eyes will look twice as large and like black velvet."

Louis Menzies' facial prescriptions were followed exactly, and the next day's rushes showed a new and handsome Jerry, with clear, olive-tinted skin.

"SOME sheik!" exulted Judy. "They'll have to deliver his mail in bushel baskets when the lady fans see our picture."

But Jerry, relieved that his face was no longer delaying production, gave his sister a mild shake and hurried out to more important business on the lot with Don.

Within the circle of supports erected the week before was stretched a huge canvas, like a topless circus tent. Waiting outside was a man with two beautiful chestnut horses. Jerry took the bridle of the larger one.

"You might tether the other in the shade of that tree over there," he told the man. "Miss Moreland won't need it for an hour or so."

Following Don, Jerry guided his horse through a flap in the canvas. In the center of the ring the new camera man, Timothy O'Day, was adjusting the tripod of a revolving, motor-driven camera.

"All set?" asked Don, walking over for an inspection.

"Just about, Mr. Kennedy. I'm ready to focus now."

"Hop on, Jerry," instructed Don, "and walk your horse around as near the canvas as you can get without bumping it."

Jerry did as requested. The camera lens followed him slowly around, keeping him in the center of focus as he made the circuit.

"Now trot."

Don set the revolving mechanism at a faster pace and, as nearly as he could judge, it kept the lens still centered on Jerry.

FOR nearly an hour, without exposing any film, Don and the camera man adjusted and readjusted the mechanism and rehearsed the action, timing it with a stop watch, while Jerry put his horse through its paces at several distances from the camera, but always making a complete circle around it. On the film, of course, he would appear to be riding along in a straight line. Don had figured out the scheme as a short cut for a "running shot"—a scene usually photographed from an automobile following along beside horse and rider.

When they were ready to make the exposures they sent for Margaret. Dressed in a long, flowing gown, with a veil flying from the high peak of her medieval head-dress, she entered the inclosure on the other horse. They rehearsed the

(*Continued on page 171*)

The Movie Maker

(Continued from page 170)

sequence quickly with her, keeping strictly to the time allowed for each bit of action. Finally Don was satisfied.

"All ready, Tim," he said, taking his place at the camera man's elbow. He would have to remember to stay there in order to keep out of line with the swinging focus of the lens. Lifting a small megaphone to his lips, he called to the two on horseback at the outer edge of the circle.

"Ready—action!"

Toward evening the little company gathered in the projection room for the day's rushes. The first shipment of films from Bozo had arrived the day before and Don had them also thrown on the screen. Hundreds of feet of English countryside with a grim old castle frowning in the background; a bridle path along an ancient moat and following a brook; a sunny lane with daisies nodding at either side; a wide road with giant oaks arched above. But not a sign of human being or habitation except the ancient castle, occasionally looming large in the foreground. The camera now and again caught a rabbit scampering across the lane. And once, in his swift flight up the broad trunk of an oak tree, a bright-eyed squirrel paused for a curious second to stare into the lens.

THEN on the screen appeared two figures riding on horseback apparently miles and miles against a blank white background. Judy giggled nervously.

"They look so—so uncanny riding along in space," she commented, "as if the earth had suddenly dissolved and left them sticking up in the air."

"Tomorrow you'll see them in England," promised Don.

Though he had spoken with such assurance, that night at home in his dark room he worked with tense anxiety to make his words come true. Would his precious machine, on which he had spent years of labor and thousands of dollars, fail him now that the moment for its big performance had arrived? It had proved out well in tests, but Don was acquainted with the occasional perversity of inanimate objects. In the early stages of his invention he had all but sold a half-interest in it for two thousand dollars. At the critical moment, however, the machine had unaccountably balked, and before Don could locate and readjust an innocent looking little screw, the entire process had been thrown out of alignment a sixteenth of an inch, ruining the demonstration. Don's prospective partner had departed with his two thousand and a hearty laugh.

In the silence and dim red glow of the dark room, only the excited breathing of the professor could be heard as he helped Don with the developing and printing. But in Don's memory that laugh echoed. He set his jaw and his hands moved more deftly. Some day that laugh would be worth half a million on the credit side. Two or three pictures like "The Crusader," and motion picture producers could not fail to recognize the enormous economy of his universal background device. Two or three pictures—if successful!

BUT there was no time to be dreaming of that now. Using a homemade machine, he put a positive print of the horseback scenes taken that morning through a strong solution of silver nitrate, allowing the film to soak in the solution until the figures of actors and horses became intensified as black silhouettes on a white transparent background. In order to preserve the original background negative sent from England, Don had had a duplicate negative made from it at Popular Players' laboratory. This he intended to use in making his combination negative.

When the

(Continued on page 172)

He Mailed a Coupon Like This

Rhodes Manufacturing Co., Dept. C-242
1418 Pendleton Ave., St. Louis, Mo.
Without obligating me, please send illustrated explanation of KRISS-KROSS stropper and your offer of a 3-Way razor FREE.
Name.....
Address.....
City.....State.....
☐Check here if interested in becoming representative.

...and it Brought Him 1129 Cool Shaves from One Single Blade!

Another Triumph for KRISS-KROSS—The Amazing Shaving Invention That Makes Old Razor Blades Keener Than New! Mr. T. Liddle, of Illinois, writes—"I have been using one of your stroppers since May, 1924. I shave every morning and am STILL ON MY FIRST BLADE!"

KRISS-KROSS marks a radical increase in shaving comfort and economy! It has captured a secret that has baffled inventors for years. Reproduces barber's flip-flop diagonal stroke with surprising accuracy. Gives any brand of razor blade the keenest cutting edge its steel can take!

Sharpens Any Make of Razor Blade!

Special Advertising Offer

Right now—to advertise KRISS-KROSS—we offer a surprising new kind of razor FREE to every new booster for KRISS-KROSS! This "mystery razor" is absolutely unique (really 3 razors in one) and cannot be bought in stores. Find out about it today. Send the coupon *above* for details. No obligation! Mail it now!

RHODES MFG. CO., Dept. C-242
1418 Pendleton Ave., St. Louis, Mo.

AGENTS! $30 A DAY AND UP!
KRISS-KROSS pays $30-$60 a day to men who act as our representatives in their home localities. Spare-time workers often earn $6-$12 extra an evening. Investigate now! Check bottom line of coupon *above* for details. Mail it today!

DO IT NOW

If you want financial independence read the story "How a Big Load Was Lifted from Harry Wilson's Mind" on page four of this issue.

To Learn Write

Begin Today — Write for my FREE BOOK. I can make a good penman of you at home during spare time. Write for my FREE BOOK, "How to Become a Good Penman." It contains specimens and tells how others mastered penmanship by the Tamblyn System. Your name will be elegantly written on a card if you enclose stamp to pay postage. Write today for Book.
F. W. TAMBLYN, 437 Ridge Bldg., Kansas City, U.S.A.

25th Year

CHICAGO TECHNICAL COLLEGE

LEARN fundamentals of DRAFTING IN 4 MONTHS

Expert draftsmen earn $60 to $150 per week. Get into this profitable field after a Chicago Tech. fascinating short course. Couple this with practical experience and be a big-pay man. Many employment opportunities. Enter any time, days or evenings. Athletics. *Also 2-yr. diploma and 3-yr. B.S. Degree Courses in Engineering, Electricity, Architecture.* Write for free 84-page "Blue Book."

Chicago Technical College
Dept. C-413 118 E. 26th St. Chicago

DRAW CARTOONS

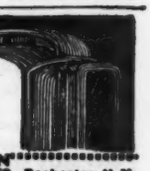
TURN YOUR TALENT INTO MONEY

Cartoonists earn from $50 to $150 per week—some even more. Remarkable *Circle System of Drawing* teaches you in half the usual time. Students from all parts of the world are enrolling for this exceptional instruction. *Personal* criticism service and up-to-the-minute instruction make it easy for National students to attain success.

Send for interesting BOOKLET and SAMPLE LESSON PLATE explaining full details of the Course and what National students are accomplishing. No salesman will call.

The National School of Cartooning,
615 Penton Building Cleveland, Ohio

TRAVEL - for 'UNCLE SAM'



RAILWAY POSTAL CLERKS
MAIL CARRIERS—POSTOFFICE CLERKS
$1700 to $3300 a Year for Life

No "lay-offs" because of strikes, poor business, etc.—sure pay—rapid advancement. City and country residents stand same chance. Common sense education sufficient—no political influence.

STEADY WORK Cut coupon and mail it before turning the page.

MEN—BOYS
18 to 45
Use Coupon Before You Lose It

COUPON

FRANKLIN INSTITUTE, Dept. W-279, Rochester, N. Y.
Rush to me, entirely free of charge, 32 page book with (1) A full description of the position checked below; (2) List of jobs now obtainable. Tell me how to get them.

☐Railway Postal Clerk ($1900 to $2700)
☐Postoffice Clerk ($1700 to $2300)
☐City Mail Carrier ($1700 to $2100)
☐Rural Mail Carrier ($2100 to $3300)

Name.....
Address.....

DOUBLE PROFITS

$544.00 IN A MONTH

With Amazing New

"TWIN" INVENTIONS

Here's something startlingly new! A revolutionary "Twin" plan of selling that pays men everywhere double profits. So read the Free Test Offer below. Then act.

ONE of the most sensational chapters in the history of direct selling has been written in the past 4 months For, almost incredible as it may sound, in that short time over 2000 men have discovered the secret of **double profits** on 4 out of 5 sales!

Twin Inventions Needed Everywhere

This unique plan is made possible by two revolutionary patented inventions. A new kind of can opener, absolutely automatic, holds the can, cuts the top out (not off) inside the rim, leaving it smooth, slick and clean—all in a couple of seconds at the turn of a crank—ends forever all stabbing and hacking with old-style can openers. A twin invention, an equally revolutionary knife, scissors and tool sharpener—operating on new, patented "magic groove" principle—sharpens automatically at a twist of the wrist.

Every home feels an instant need for at least one of these amazing new devices. Four out of five buy **both** because of unique interchangeable feature, both operating from same tiny wall bracket. There is not room for all the sensational details here. Our plan includes practical sales training course. We furnish everything. Exclusive territories. Write today for Free Test Offer and proof of $68 to $150 a week.

$544.00 FIRST MONTH

"Speedo sells to 9 out of 10 prospects. Here's the result of my first month's work. June 13—60 Speedos; June 20—84 Speedos; June 30—192 Speedos; July 6—288 Speedos."
M. Ornoff, Va.

CENTRAL STATES MFG. CO.
(Established over 20 years)
Dept. C-841 4500 Mary Ave. St. Louis, Mo.

Central States Mfg. Co., Dept. C-841.
4500 Mary Ave., St. Louis, Mo.

Rush me details of your double profits plan and Free Test Offer.

Name.....

Address.....

Town..... State.....

The Movie Maker

(Continued from page 171)

intensified print of the horseback scenes was dry, he took a strip of unexposed positive and adjusted it on his machine. Over it he fastened the English background negative, and on top of that he placed the print of the silhouetted figures on horseback. Tightening the delicate mechanism of his device, an intricate elaboration of an automatic printing machine accurate to a ten-thousandth of an inch, he ran the three strips of film together through the printing process.

The result was a positive print of the English background with the blank outlines of horses and actors superimposed upon it, the silhouettes formerly black now showing up white and transparent when the print was run through the developing hypo. After allowing it to dry on a revolving rack in front of a large electric fan, Don placed this new positive over a fresh strip of negative film, and on top of the two adjusted an ordinary positive of the horseback scenes. Repeating the double printing process, he obtained a perfect combination negative showing Jerry and Margaret riding against the English background.

IT WAS two o'clock when Don held a few frames of the completed negative against the ruby light and with a magnifying glass noted the exact placement of the figures. Enlarged on the screen, not the slightest deviation would show. Now to make a positive print to run in the projection room the following day.

The professor had been gently snoring for hours in the next room, but it was dawn when Don, too happy to know he was tired, tumbled into bed.

In the busy days that followed, however, many problems called for solution. Bozo had shown almost a genius for finding locations to fit the action of the scenario. His timing records, faithfully included with each reel sent across, were models of accuracy, and Don had little trouble synchronizing with them the action shot against blank backgrounds in Cinema City. Occasionally, when the action involved an impossible combination of actors with background, Judy was called upon to do some rewriting. Usually it was a simple matter, but one day she rebelled.

"I *can't* rewrite this scene, Don—there's no way to do it! Jerry's just got to leap the chasm or we'll miss the big thrill we need at that point."

"I know it," agreed Don. "But I don't see how it's possible to trick our way this time."

JUDY studied the still picture Bozo had taken from the bottom of a deep gorge. The two sides of the ravine rose up sheer against the horizon, the top apparently two hundred feet above the level of the camera.

"We might find a location something like it in one of the canyons around here," she suggested.

"Can't waste time hunting for it," replied Don. "Besides, I don't like to have Jerry take the risk of leaping such an ungodly hole."

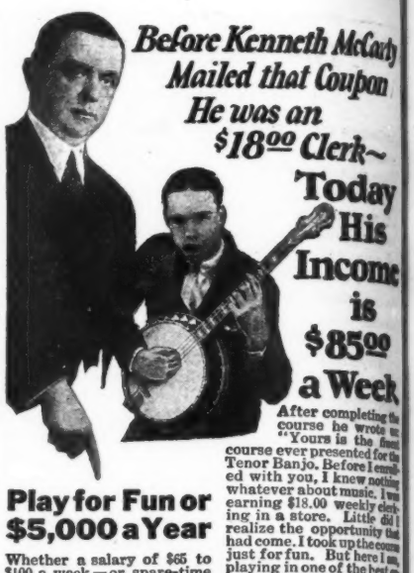
"I don't either," admitted Judy. "Let's ask the professor if he can't help us out."

Professor Mahrlenburg had appropriated one of the deserted stages as his workshop, and there they found him supervising the construction of combination large and miniature sets drawn to scale from the photographs Bozo had sent of interior scenes, the courtyard, and the drawbridge of the old castle. At one side of the workshop, near a large window, an artist was reproducing part of a photograph on the upper portion of a large glass screen set in a wooden frame.

"Let me keep the picture and study it," the professor said, when they had explained their problem. "Maybe I can manage, but I must first work it out on paper."

Two days later, under his directions, a small model of heavy

(Continued on page 173)



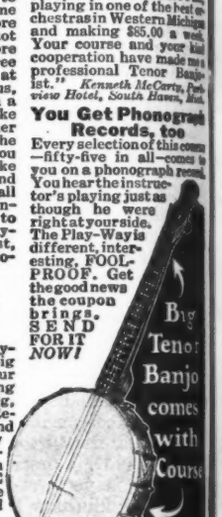
Before Kenneth McCarty Mailed that Coupon He was an $18.00 Clerk—

Today His Income is $85.00 a Week

After completing the course he wrote us: "Yours is the finest course ever presented for the Tenor Banjo. Before I enrolled with you, I knew nothing whatever about music. I was earning $18.00 weekly clerking in a store. Little did I realize the opportunity that had come. I took up the course just for fun. But here I am, playing in one of the best orchestras in Western Michigan and making $85.00 a week. Your course and your kind cooperation have made me a professional Tenor Banjoist." *Kenneth McCarty, Parkview Hotel, South Haven, Mich.*

You Get Phonograph Records, too

Every selection of this course—fifty-five in all—comes to you on a phonograph record. You hear the instructor's playing just as though he were right at your side. The Play-Way is different, interesting, FOOL-PROOF. Get the good news the coupon brings. SEND FOR IT *NOW!*



Play for Fun or $5,000 a Year

Whether a salary of $65 to $100 a week—or spare-time playing at $5, $10, $15 or more a night—interests you or not—think of the fun in store for you. In one to three months we can train you at home to play this marvelous, melodious instrument with a fine, easy skill that will make you the envy of all other eyes. You're passing up the *best times* of your life if you pass up an opportunity like this to learn at slight cost and with no inconvenience at all the world's most popular instrument. Decide NOW to learn more about The Play-Way—the quickest, surest, short-cut to social and professional success.

FREE Book Tells How

Send at once for "The Play-Way to Popularity and Big Pay." Learn all about our unique method of training you at home; about the big, Tenor Banjo, Phonograph Records and Outfit that we send you along with your very first lesson. Pleasure, popularity and big pay are open to *you!* Get this FREE Book. Clip the coupon while it's here before your eyes!

Get Big Free Book

A. F. Bloch, President,
New York Academy of Music,
Studio 5038, 100 Fifth Avenue,
New York City.

Send me the book that started McCarty. No obligation whatsoever on my part, understand.

Name.....

Address.....

AROUND THE WORLD WITH THE INTERNATIONAL CLUB

Exchange letters, post cards, magazines; form interesting and educational friendships with members in Old Mexico, Spain, Cuba, Porto Rico, Central and South America. Language students, travelers, educated young people everywhere, send 10 cents in stamps for booklet and full particulars.

INTERNATIONAL CLUB, BOX 670, HAVANA, CUBA.

RAISE BELGIAN HARES

New Zealand Reds — Chinchillas — Flemish Giants
MAKE BIG MONEY—We Supply Stock and pay you following prices for all you raise: Belgian Hares $2 each—New Zealands $3 each—Chinchillas $4 each—Flemish Giants $5 each. 32-page illustrated book, catalog and contract, also copy of Fur Farming magazine, tells how to raise skunk, mink, fox, etc., for big profits, all for 10c. Address OUTDOOR ENTERPRISE CO., Box 66, Holmes Park, Missouri

Learn Photography at HOME

Make money taking pictures. Prepare quickly during spare time. Also earn while you learn. No experience necessary. New easy method. Nothing else like it. Send at once for free book, *Opportunities in Modern Photography*, and full particulars.
AMERICAN SCHOOL OF PHOTOGRAPHY
Dept. 1363, 3601 Michigan Ave. Chicago, U. S. A.

The Movie Maker

(Continued from page 172)

cardboard, burlap, and artificial foliage, with tiny trees at its base, was set up near one end of the lot. It was a four-foot replica of the gorge, but extended not quite to the top shown in the photograph. This omission was supplied eighty feet beyond the model and directly in line with it, where the professor had two sturdy platforms constructed, fifteen feet in height, the distance between them apparently a continuation of the tiny gap between the sides of the model in the foreground. Over the platforms the professor carelessly draped rough grass mats, holding them in place with several large stones, a small log or two, and bushes. The platform at the right extended beyond the camera angle into a runway upon which Jerry's horse could get a good start for the leap. A painted back drop behind the platforms completed the set.

When Jerry was ready, Tim O'Day, with the camera six feet away from the miniature set, found the focus.

"Take a squint at that," he said to Don. "It's tricky."

AND when the day's rushes appeared on the screen, it proved "tricky" indeed—a perfect illusion. Jerry reined in his galloping horse at the very edge of the chasm, apparently a dizzy two-hundred-foot drop. For one breath-taking moment the splendid creature balanced there, his forefeet high in the air. Then he whirled and galloped away. Again Jerry urged him on and the horse took the chasm in a mighty leap.

* * *

The end of September was rushing toward them with the speed of an express train when Don, immersed in the rapid solving of each day's difficulties, suddenly saw the Big Problem looming immediately before him. It was Saturday noon and he had just finished passing out the weekly checks to their small number of employees. Judy was waiting for him in the office when he returned to discuss a slight change in one sequence. But his sudden glimpse of the Big Problem had shut everything else out of his mind.

"Judy!" he exclaimed, sitting down at the table beside her. "We've just three thousand left and next week I've got to send Bozo more money and pay the electric light bills!"

"So I've been thinking," replied Judy. "And what are you planning to do about it?"

"Gosh!" Don mopped his forehead with a dingy handkerchief. "Thought I'd have the picture far enough along by this time to show it to some millionaire and get him to buy a share in my invention."

"AND what millionaire have you in mind?" asked Judy.

"No one in particular." Don looked troubled. "The truth is, I got so absorbed in making the picture I forgot all about the money end of it."

"Well, even if you did know anyone with money—and you don't," commented Judy helpfully, "no one could make head or tail of the picture in its present state."

"I know it," groaned Don. "Guess I'll have to drop everything for a while and find some other way to sell shares in my machine."

"And get cheated out of your rights in it!" scolded Judy. "Don Kennedy, you're no business man."

"The no's have it," agreed Don mournfully. Leaning his chin on his hand, he slumped against the table for a discouraged moment.

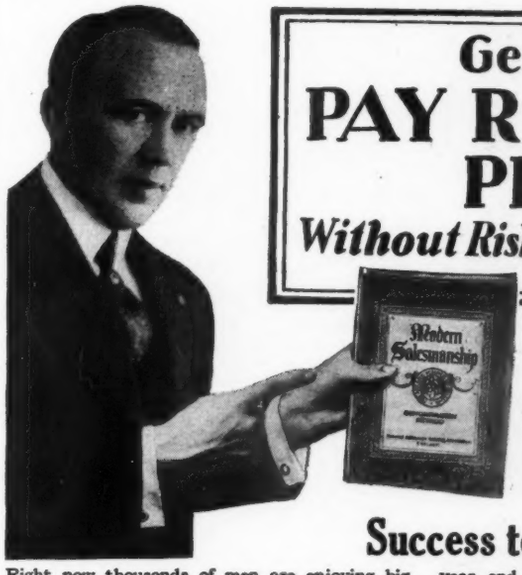
Judy gave him a motherly pat.

"How would you like to have fifty thousand dollars?" she asked brightly.

"Don't be a piker!" Don grinned at her cynically. "Wish for a million."

Judy considered him with thoughtfully narrowed eyes.

(Continued on page 174)



Get This PAY RAISING PLAN *Without Risking One Cent!*

See for Yourself Why it has Brought Such Amazing Success to Thousands of Men

Right now thousands of men are enjoying big earnings they never dreamed of five years ago—just because they wrote me for a simple pay-raising plan that I am now ready to send to you absolutely free. These men had no special advantages, but they *did* have ambition, and they needed little more than the incentive they received from "Modern Salesmanship" to make them succeed in a big way. If you, too, are ambitious for the good things of life, but do not know exactly how to go after them, this book contains a message that may mean the turning point in your life.

Big Demand for Trained Salesmen

For "Modern Salesmanship" will show you how you can quickly qualify for a city or traveling sales position in which your earnings may be practically unlimited. It blasts dozens of old theories, explains the science of selling in simplest terms, and proves that almost any man can become a Master Salesman. There must be something behind a system that enabled a former dishwasher like Barichievich of San Francisco to step out and earn over $100 a week as a salesman. There must be power behind an Association that received calls in its Free Employment Bureau for over 50,000 salesmen last year, and has assisted men like Englehardt, Halloman, and hundreds of others to positions that pay them up to five and six times their former incomes. And if this plan could do for you one-half as much as it has done for these men, wouldn't it be worth your time and a two-cent stamp to get a chance to look it over? Then why not mail the coupon for your Free copy of "Modern Salesmanship"? There is no obligation, and it may repay you a thousand-fold.

National Salesmen's Training Association
Dept. C-190 N.S.T.A. Bldg. Chicago, Ill.

National Salesmen's Training Association,
Dept. C-190, N.S.T.A. Bldg., Chicago, Ill.

Please send me free your illustrated book, "Modern Salesmanship," and particulars of your remarkable pay-raising plan.

Name.....

Address.....

City..... State.....

Age..... Occupation.....

Learn to PAINT SIGNS and SHOW CARDS

We quickly teach you by mail, or at school, in spare time. Enormous demand. Big future. Interesting work. Oldest and foremost school.

EARN $50 TO $200 WEEKLY

John Vassos, N. Y., gets $25 for single show card. Crawford, B. C., writes: "Earned $200 while taking course." Don't delay. Send today for complete information, samples and guarantee.

DETROIT SCHOOL OF LETTERING
159 Stimson Ave. Est. 1899 DETROIT, MICH.

ELECTRICITY

My first job after leaving school took 2 hours and I received $65.00 for the inspection. I worked up to over $600.00 a month and expect to clear $10,000 the first year.
Paul A. Carson.

You learn by Doing—

Actual experiments in our practical shops and laboratories teach you a lot branches of electricity.

B.S. Degree 2 years

No matter what your education or age, you'll find a place at S. O. E. and a course to meet your needs. 3 months D.C. and A.C. armature winding, auto electricity, electrical refrigeration or radio courses fit you for fast advancement. Learn practical electricity in 6 months; junior electrical engineering, commercial electrical engineering in 12 months. Electrical Engineering 2 years. Step in the limelight of success. Start now. Send for FREE ILLUSTRATED CATALOG TODAY.

SCHOOL of ENGINEERING of Milwaukee
Dept. PS 328 163 East Wells St., Milwaukee, Wis.

Learn **Advertising at HOME**

Send your name and address for free booklet giving interesting information and vital facts about Advertising. Find out how we prepare you at home, in your spare time, for the opportunities open in this fascinating business. Practical work. No text books. Old established school. Successful graduates everywhere. Just the plan you have always wanted. Write today. No obligation.

PAGE-DAVIS SCHOOL OF ADVERTISING
Dept. 1363, 3601 Michigan Ave., Chicago, U. S. A.

How to Work with Tools and Wood

This book explains in a simple, straightforward manner all the processes of working with tools and wood. It takes all the mystery out of using tools and enables you to spend many interesting and profitable hours in your home workshop. All details are clearly explained.

Price $1.00

Popular Science Monthly
250 Fourth Ave., New York City

FOREST RANGERS

Do you enjoy outdoor life close to Nature? Get Forest Ranger job; salary $125-$200 month and home furnished; plenty fishing, hunting, trapping; no strikes or shut-downs; vacations on full pay. For further particulars, write

NORTON 2540 Temple Court DENVER, COLO.

PLAY PIANO BY EAR

SIMPLE—EASY—DELIGHTFUL

Astonishing new way teaches you to play song hits perfectly. If you can hum a tune, the Niagara method teaches you to play by ear. No teacher—no previous instruction necessary. No tedious do-re-mi daily practice—just 20 brief entertaining lessons easy to master.

Learn at home in your spare time!

Be a master of jazz and melody. Learn the newest bass and syncopation styles—trick endings. Make yourself popular in any crowd. Send for the Free Book "The Niagara Secret"—telling how. If 10c (coin or stamps) is enclosed you will also receive fascinating booklet on "How to Entertain at Piano". Send now!

Niagara School of Music, 273 Cleveland Ave., Niagara Falls, N.Y.

Where the Big Ones Rise!

SOME place, far off the beaten track, there's a shimmering lake or a cold, rushing stream where the "big ones" lurk. You know the place!

Pack up your old kit bag — take a friend along in the chummy sidecar, and be on your way to a holiday crowded with happy, care-free sport.

The Harley-Davidson takes you wherever you want to go — comfortably, swiftly and *economically.* Upkeep? *2¢ per mile pays for gas — oil — tires and all!* Front and rear brakes, and other great features are built into the new 1928 models.

Prices as low as $310 f. o. b. factory, and your dealer's convenient Pay-As-You-Ride-Plan make the Harley-Davidson easy to own. You'll enjoy a demonstration. Send coupon for catalog.

HARLEY-DAVIDSON MOTOR COMPANY
DEPT. P. S., MILWAUKEE, WIS.

The Single — famous Harley-Davidson solo mount that travels 80 miles to the gallon of gas. Priced at $235 complete, f. o. b. factory.

HARLEY-DAVIDSON
Motorcycles

HARLEY-DAVIDSON MOTOR CO.,
Dept. P. S., Milwaukee, Wis.
Interested in ☐ Twin ☐ Single.
Send catalog and complete details.
Name.....
Address.....

Mail the Coupon

The Movie Maker

(Continued from page 178)

"I know a girl who wants to get into the movies," she announced casually.

"Do you know any girl who doesn't?" jeered Don. "But maybe your friend owns a beauty contest cup!"

"Oh, no. You can get that kind by the barrel." Judy dismissed the multitude with a shrug. "My girl owns a father—and her father owns a string of newspapers from New York to San Francisco!"

"Silas Rogers!" exclaimed Don. "I heard he was coming to Los Angeles to start a new evening paper."

"He and his daughter are here now," Judy informed him. "We lived in the same town when Mabel and I were little, so I looked her up when the papers announced her arrival. Mabel's dying to meet you!"

"Oh, so you've got the scheme all laid out!" Don looked at Judy suspiciously.

"I HAVE! It's about time someone thought of money," replied his defiant scenarist. "Mabel's father is taking her to Everglade Grove next Tuesday night and the five of us are just going to happen in and Mabel will invite us to their table and . . ."

"And we'll take the fifty thousand and tip the head waiter!" quoted Don. "Your scheme sounds weak to me, but maybe you can put it across. You'll have to count the professor and me out, though. No clothes."

"You can buy some!" Judy retorted tartly. "That's why I'm giving you till next Tuesday. Get a tux for yourself and a swallowtail for the professor—with all the accessories."

"No." Don's tone was final. "My cords and the old blue serge will have to do me till we get this picture out of the woods."

"Then you'll never get it out of the woods. If you want to be successful you've got to look that way. Jerry's getting a new tux, Margaret has promised to deck herself out like the Queen of Sheba—and I think you'll like my new dress." Judy smiled with pleasant self-approval. Then she turned a severe frown on the shabby young director. "Don, for once in your life you've just got to look decent!"

"Thanks for the implied compliment," Don replied, unsmiling. "But I'll wait till I can spend my own money for clothes. Don't forget that I'm living on your brother's charity and using Miss Moreland's money for the picture!"

JUDY stared at his unrelenting chin, at his grimly steady, tired eyes. Suddenly and quite unexpectedly, she had to gulp back a sob. She blinked her eyes quickly.

"I'm just trying to help you," she quavered. "It'll cost only about two hundred dollars to buy those clothes and give us a chance at the fifty thousand—and if we don't get the fifty thousand, what good will the two hundred be to us? We'll be sunk! You've been grubbing along for five years and—"

"And I haven't put anything across," Don finished for her grimly. "I guess you're right at that—the only way to get ahead is to throw a big bluff!" he concluded bitterly. Then he laughed at the meek little face opposite him—so unlike Judy's usually saucy expression. "Oh, well, I'll give your plan a try. Tell me what you want me to do."

"Attaboy!" A rainbow of smiles broke over Judy's face. "Now we'll get the picture on its feet. You can't expect anyone to back you till you put up a front!"

It's a great scheme of Judy's—if it works. Fifty thousand dollars! That sum would carry them a long way on their desperate enterprise. But can they capture it? In next month's installment — more interesting adventures, and more fascinating revelations of the inside secrets of the movie game.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.